U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
PB-298 074

Energy from the West Policy Analysis Report

Oklahoma Univ, Norman Science and Public Policy Program

Prepared for

Environmental Protection Agency, Washington, DC Office of Energy, Minerals and Industry

Mar 79

United States
Environmental Protection
Agency

Office of Energy, Minerals, and
Industry
Washington DC 20460

EPA-600/7-79-083
March 1979

PB 298074

Research and Development

EPA

Energy from the West

Policy Analysis Report

Interagency Energy/Environment R&D Program Report

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

MAR 21 1979

1. REPORT NO. EPA-600/7-79-083	2.	3. RECIPIENT'S ACCESSION NO. PB298074
4. TITLE AND SUBTITLE Energy From the West: Policy Analysis Report		5. REPORT DATE March 1979 issuing date
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Irvin L. White, et al		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Science and Public Policy Program University of Oklahoma Norman, OK 73019		10. PROGRAM ELEMENT NO. EHE 624C
		11. CONTRACT/GRANT NO. 68-01-1916
12. SPONSORING AGENCY NAME AND ADDRESS US Environmental Protection Agency Office of Research and Development Office of Energy, Minerals and Industry Washington, DC 20460		13. TYPE OF REPORT AND PERIOD COVERED Final July '75-February '79
		14. SPONSORING AGENCY CODE EPA/600/17

15. SUPPLEMENTARY NOTES

This project is part of The EPA-planned and coordinated Federal Interagency Energy/Environment R&D Program

16. ABSTRACT

This volume reports the results of policy analyses conducted as a part of a three-year "Technology Assessment of Western Energy Resource Development." The study examines the development of six energy resources (coal, geothermal, natural gas, oil, oil shale, and uranium) in eight western states (Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah, and Wyoming) during the period from the present to the year 2000. Previously published reports have described the analytical structure and conduct of the study, the technology for developing western energy resources and reported the results of an analysis of the impacts likely to result when western energy resources are developed. This report relates those impacts to the social and political context within which this development is and will be taking place. Nine major problem and issue categories are analyzed: water quality, water availability, air quality, land use and reclamation, housing, growth management, capital availability, transportation, and energy facility siting. The final chapter discusses policy responses available to policy makers at various levels of government, in Indian Trades, and in the private sector.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Government Policies	Technology Assessment Western Energy Resourse Development	97 G

18. DISTRIBUTION STATEMENT Unlimited	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 857
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE PC A99/MF A01

i

EPA Form 2220-1 (9-73)

EPA-600/7-79-083
March 1979

Energy From the West: Policy Analysis Report

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Contract Number 68-01-1916

Energy
from
the
West

DISCLAIMER

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FOREWARD

The production of electricity and fossil fuels inevitably impacts Man and his environment. The nature of these impacts must be thoroughly understood if balanced judgements concerning future energy development in the United States are to be made. The Office of Energy, Minerals and Industry (OEMI), in its role as coordinator of the Federal Energy/Environment Research and Development Program, is responsible for producing the information on health and ecological effects - and methods for mitigating the adverse effects - that is critical to developing the Nation's environmental and energy policy. OEMI's Integrated Assessment Program combines the results of research projects within the Energy/Environment Program with research on the socioeconomic and political/institutional aspects of energy development, and conducts policy-oriented studies to identify the tradeoffs among alternative energy technologies, development patterns, and impact mitigation measures.

The Integrated Assessment Program has supported several "technology assessments" in fulfilling its mission. Assessments have been supported which explore the impact of future energy development on both a nationwide and a regional scale. Current assessments include national assessments of future development of the electric utility industry and of advanced coal technologies (such as fluidized bed combustion). Also, the Program is conducting assessments concerned with multiple-resource development in two "energy resource areas":

- Western coal states
- Lower Ohio River Basin

This report, which reports the results of the analysis of selected policy responses to the impacts likely to be experienced when six energy resources are developed in eight western states, is one of three major reports produced by the "Technology Assessment of Western Energy Resource Development" study. (The other two reports describe the technologies likely to be used and report impact analysis results.) Nine major categories of problems and issues are analyzed in separate chapters: water quality, water availability, air quality, land use and reclamation, housing, growth management, capital availability, transportation, and energy facility siting. A final chapter discusses policy responses available to policy makers at various levels of government, in Indian Trades, and in the private sector.

We would like to receive your comments concerning this report. Such comments will help us to improve the usefulness of the products produced by our Integrated Assessment Program.

Steven R. Reznek

Acting Deputy Assistant Administrator
for Energy, Minerals and Industry

PREFACE

This policy analysis report has been prepared as a part of "A Technology Assessment of Western Energy Resource Development" being conducted by an interdisciplinary research team from the Science and Public Policy Program (S&PP) of the University of Oklahoma for the Office of Energy, Minerals and Industry (OEMI), Office of Research and Development, U.S. Environmental Protection Agency (EPA). This study is one of several being conducted under the Integrated Assessment Program established by OEMI in 1975. Recommended by an interagency task force, the purpose of the Program is to identify economically, environmentally, and socially acceptable energy development alternatives. The overall purposes of this particular study are to identify and analyze a broad range of consequences of energy resource development in the western U.S. and to evaluate and compare alternative courses of action for dealing with the problems and issues either raised or likely to be raised by development of these resources.

The Project Director was Irvin L. (Jack) White, Assistant Director of S&PP and Professor of Political Science at the University of Oklahoma. White is now Special Assistant to Dr. Stephen J. Gage, EPA's Assistant Administrator for Research and Development. Michael D. Devine, Professor of Industrial Engineering and Director of S&PP, served as Project Director during the final stages of writing this report. Steven C. Ballard, Research Fellow in S&PP and Assistant Professor of Political Science has had primary management responsibility for producing this report. EPA Project Officer is Steven E. Plotkin, Office of Energy, Minerals, and Industry, Office of Research and Development. Michael A. Chartock, Associate Professor of Zoology and Research Fellow in S&PP and R. Leon Leonard, now a senior scientist with the Radian Corporation in Austin, Texas, formerly an Associate Professor of Aerospace, Mechanical, and Nuclear Engineering, and Research Fellow in S&PP, were Co-Directors of the Research Team. Other S&PP team members are: Edward J. Malecki, Assistant Professor of Geography; Edward B. Rappaport, Visiting Assistant Professor of Economics; Frank J. Calzonetti, Research Associate (Geography); Timothy A. Hall, Research Associate (Political Science); Gary D. Miller, Graduate Research Assistant (Civil Engineering and Environmental Sciences); Allyn R. Brosz, Graduate Research Assistant (Political Science); and Mark S. Eckert, Graduate Research Assistant (Geography). Professors Malecki and Rappaport are also Research Fellows in S&PP. Robert W. Rycroft, Assistant Professor of Political Science, University of Denver, Larry W. Parker, Research Assistant (Political Science), and Phil Kabrich, Research Assistant (Political Science) also participated as team members in the preparation of this final report.

Don E. Kash, former Director of S&PP and Professor of Political Science and now serving as Chief of the Conservation Division of the U.S. Geological Survey, assisted the team in a number of ways.

ABSTRACT

This is a report of the results of policy analyses conducted as a part of a three-year "Technology Assessment of Western Energy Resource Development." The study examines the development of six energy resources (coal, geothermal, natural gas, oil, oil shale, and uranium) in eight western states (Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah, and Wyoming) during the period from the present to the year 2000. Previously published reports have described the analytical structure and conduct of the study and reported results of a preliminary analysis of the impacts that are likely to result when western energy resources are developed. This report relates those impacts to the social and political context within which this development is and will be taking place. Part I describes the national and regional context; Part II describes how the policy analyses were performed and reports the results of analyses of nine major problem and issue categories: Water Quality, Water Availability, Air Quality, Land Use, Housing, Planning and Growth Management, Capital Availability, Transportation, and Energy Facility Siting; and Part III identifies and discusses problems and issues which cut across either several or all of the separate problems and issues analyzed in Part II.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAR	Association of American Railroads
AC	alternating current
acre-ft/yr	acre-feet per year
BACT	Best Available Control Technology
bbl/day	barrels per day
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BOD	biochemical oxygen demand
Btu	British thermal unit
BuRec	Bureau of Reclamation
CAA	Clean Air Act
CERT	Council of Energy Resource Tribes
CHESS	Community Health and Environmental Surveillance System
CO	carbon monoxide
COG's	councils of government
CONEG	Coalition of Northeastern Governors
CWA	Clean Water Act
CWIP	construction work in progress
CZMA	Coastal Zone Management Act
dBA	decibel(s) A-weighted
DC	direct current
DOE	Department of Energy
DOI	Department of the Interior
DOT	Department of Transportation
EDA	Economic Development Administration
EIS	environmental impact statement(s)
EMARS	Energy Minerals Allocation Resource System
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
ERA	Economic Regulatory Administration
ERDA	Energy Research and Development Administration
EMS	emergency medical services
ESECA	Energy Supply and Environmental Coordination Act of 1974
FEA	Federal Energy Administration
FERC	Federal Energy Regulatory Commission
FGD	flue gas desulfurization
FHA	Federal Housing Administration
FHLMC or Freddie Mac	Federal Home Loan Mortgage Corporation
FmHA	Farmers Home Administration

FNMA or Fannie Mae	Federal National Mortgage Association
4-R Act	Railroad Revitalization and Regulatory Reform Act of 1976
FPC	Federal Power Commission
FTC	Federal Trade Commission
FWPCA	Federal Water Pollution Control Act
FY	fiscal year
GNMA or Ginnie Mae	Government National Mortgage Association
HC	hydrocarbon(s)
HEW	Department of Health, Education and Welfare
HUD	Department of Housing and Urban Development
HVTL	high voltage transmission line(s)
ICC	Interstate Commerce Commission
IRS	Internal Revenue Service
kV	kilovolt(s)
kwh	kilowatt-hour
LAER	lowest achievable emission rate
lb(s)	pound(s)
LNG	liquefied natural gas
MESA	Mining Enforcement and Safety Administration
MMtpy	million tons per year
MWe	megawatt-electric
NAAQS	National Ambient Air Quality Standards
NAS	National Academy of Sciences
NEP	National Energy Plan
NEPA	National Environmental Policy Act
NHSC	National Health Services Corps
NO_x	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NRDC	Natural Resources Defense Council
NSPS	New Source Performance Standards
OCS	outer continental shelf
OPEC	Organization of Petroleum Exporting Countries
ORV	off-road vehicle(s)
OSM	Office of Surface Mining, Reclamation, and Enforcement
PSD	prevention of significant deterioration
Q	quadrillion (10^{15}) Btu's
R&D	research and development
RARE	Roadless Area Review and Evaluation
RD&D	research, development and demonstration
S&PP	Science and Public Policy Program
SEAM	Surface Environment and Mining Program
SEPA	state environmental policy act
SIP	state implementation plan(s)
SNG	synthetic natural gas
SO_2	sulfur dioxide
SRI	Stanford Research Institute
TA	technology assessment
TSP	total suspended particulates

UCRB	Upper Colorado River Basin
UMRB	Upper Missouri River Basin
USGS	U.S. Geological Survey
U_3O_8	uranium oxide and/or yellowcake
WESCO	Western Gasification Company
WESPO	Western Governors' Policy Office
WISA	Wyoming Industrial Siting Administration
WSGA	Wyoming Stock Growers Association

CONVERSION TABLE

BTU CONTENT OF ENERGY FORMS

Electricity: 1 kWh = 3413 Btu.

Natural gas: 1 cubic foot = 1000 Btu.

Petroleum:
1 barrel (bbl) = 42 gallons
crude oil--1 bbl = 5.8 million Btu;
distillate fuel--1 bbl = 5.8 million Btu:
residual fuel --1 bbl = 6.3 million Btu;
gasoline--1 bbl = 5.3 million Btu;
Uranium--1 pound U_{235} = 3.6 X 10^{10} Btu.

1 million = 10^6
1 billion = 10^9
1 trillion = 10^{12}

1 Quad = 10^{15} Btu
1 megawatt = 10^6 Watts
1 kilowatt = 10^3 Watts

ENERGY

UNITS	joule	cal	Btu	kWh
1 joule	1	2.389 X 10^{-1}	9.48 X 10^{-4}	2.778 X 10^{-7}
1 cal	4.186	1	3.97 X 10^{-3}	1.163 X 10^{-6}
1 Btu	1.055 X 10^{3}	2.52 X 10^{2}	1	2.93 X 10^{-4}
1 kWh	3.6 X 10^{6}	8.6 X 10^{5}	3.413 X 10^{3}	1

RATE

UNITS	Cubic Meter/Year	Gallon/Minute	Acre-Feet/Year
1 gallon/minute	1.9898 X 10^{3}	1	1.613
1 acre-foot/year	1.2335 X 10^{3}	6.2 X 10^{-4}	1

PRESSURE

UNITS	atmospheres	kilograms/square centimeter	pounds per square inch	N/m², Pa
1 atmosphere	1	1.033	1.469 X 10^{1}	1.03 X 10^{5}
1 pound/sq. inch	6.804 X 10^{-2}	7.03 X 10^{-2}	1	6894.76

LENGTH

UNITS	Meters	Feet	Yards	Miles
1 meter	1	3.28	1.093	6.21 X 10^{-4}
1 yard	9.14 X 10^{-1}	3.0	1	5.68 X 10^{-4}
1 mile	1.609 X 10^{3}	5.28 X 10^{3}	1.76 X 10^{3}	1

WEIGHT

UNITS	Kilogram	Pound	Metric Ton	Ton (Short)
1 kilogram	1	2.2046	1.0 X 10^{-3}	1.102 X 10^{-3}
1 metric ton	1.0 X 10^{3}	2.205 X 10^{3}	1	1.102
1 ton (short)	9.072 X 10^{2}	2.0 X 10^{3}	9.078 X 10^{-1}	1

VOLUME

UNITS	Liters	Cubic Feet	Acre-Feet	Gallons
1 liter	1	3.531 X 10^{-2}	8.107 X 10^{-7}	2.642 X 10^{-1}
1 acre-foot	1.234 X 10^{6}	4.356 X 10^{4}	1	3.259 X 10^{5}
1 gallon (U.S.)	3.785	1.337 X 10^{-1}	3.068 X 10^{-6}	1

AREA

UNITS	Square Meters	Square Feet	Square Yards	Acres	Square Miles
1 square meter	1	1.076 X 10	1.196	2.471 X 10^{-4}	3.86 X 10^{-7}
1 square yard	8.361 X 10^{-1}	9.0	1	2.066 X 10^{-4}	3.228 X 10^{-7}
1 acre	4.047 X 10^{3}	4.35 X 10^{4}	4.84 X 10^{3}	1	1.562 X 10^{-3}
1 square mile	2.59 X 10^{6}	2.788 X 10^{7}	3.098	6.402 X 10^{2}	1

atm = atmospheres
psi = pounds per square inch
cal = calorie
N/m², Pa = Newton per square meter, Pascal
Btu = British thermal units
kWh = kilowatt hour

ACKNOWLEDGEMENTS

The research reported here could not have been completed without the assistance of a dedicated administrative support staff. Members of the staff are an integral part of the interdisciplinary team approach employed by the Science and Public Policy Program. This staff is headed by Janice Whinery, Assistant to the Director, and Ellen Ladd, Clerical Supervisor. Staff members are: Cyndy Allison, Amber Adams, Pam Odell and Judy Williams. Other members of the staff that assisted in the earlier preparation of this report were: Nancy Heinicke, Patti Mershon, Brenda Skaggs, and Julia Leonard.

The research support staff is headed by Martha Jordan, Librarian. Research Team Assistants are Mary Sutton, Diane Dean, Lorna Caraway, and David Sage. Phil Kabrich assisted as Research Team Assistant in the final production of the report.

Nancy Ballard, graphics arts consultant, designed the title page. Virginia Newman, graphic artist, assisted with the graphics in the final production of the report. Gary Parent, Graduate Research Assistant in Political Science, contributed to the water policy analysis.

Steven E. Plotkin, EPA Project Officer, has provided continuing support and assistance in the preparation of this report. In addition to his assistance as an expert critic, he was an invaluable source of information; and he assisted directly in the water policy analysis in Chapters 4 and 5.

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The Advisory Committee met on April 24, 1978, at the University of Oklahoma to review an earlier draft of this report. Mr. Bruce Glenn, Bureau of Reclamation, Denver; Mr. Marvin Ott, Office of Technology Assessment, Washington; and Mr. Terry Thoem, Environmental Protection Agency, Denver also attended that meeting and contributed to the review.

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PART I: THE CONTEXT OF WESTERN ENERGY RESOURCE DEVELOPMENT

INTRODUCTION

Background

This is a report of the results of policy analyses conducted as a part of a three-year "Technology Assessment of Western Energy Resource Development." The assessment is being performed for the Office of Energy, Minerals and Industry, Office of Research and Development, U.S. Environmental Protection Agency by an interdisciplinary research team from the Science and Public Policy Program (S&PP), University of Oklahoma.[1] The major objectives of the study are to identify and analyze a broad range of consequences of energy resource development in the western U.S. and to evaluate and compare alternative courses of action for dealing with these consequences. Other reports[2] present the results of analyses undertaken to identify and evaluate the impacts likely to occur at specific sites and within the eight-state study area when energy development takes place. The purpose of this report is to relate these impact findings to the social and political context within which they would occur, identify the problems and conflicts that can be anticipated, and describe, evaluate, and compare alternative policies and implementation strategies for dealing with these problems and conflicts.

---

[1] Two subcontractors, Radian Corporation, Austin, Texas, and Water Purification Associates, Cambridge, Massachusetts, provided major technical support.

[2] Preliminary results of our impact analyses were reported in White, Irvin L., _et al_. _Energy From The West: A Progress Report of a Technology Assessment of Western Energy Resource Development_, 4 vols. and _Executive Summary_. Washington, D.C.: U.S., Environmental Protection Agency, 1977. (NTIS Order Nos.: Vol. I, PB-271 752, Vol. II, PB-271 753, Vol. III, PB-271 754, Vol. IV, PB-272 243.) The results of our initial impact analyses were extended and refined during the second and third years of the project. Results of these analyses are reported in White, Irvin L., _et al_. _Energy From the West: Impact Analysis Report_. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

Scope

The study focuses on the development of six energy resources in the eight-state area and at the six sites shown in Figure 1. Coal, geothermal, natural gas, oil, oil shale, and uranium are the six energy resources being considered; the technological alternatives being assessed for developing them are identified in Table 1. The time period during which the consequences of development are being assessed extends to the year 2000.

TABLE 1: DEVELOPMENT ALTERNATIVES[1]

Coal:
- Surface and Underground Mining
- Direct Export by Unit Train and Slurry Pipeline
- Electric Power Generation
- Gasification
- Liquefaction
- Transportation by Pipeline and EHV

Oil Shale:
- Underground Mining
- Surface Retorting
- Modified In-Situ
- Transportation by Pipeline

Uranium:
- Surface, Underground, and Solutional Mining
- Milling
- Transportation by Truck

Oil and Natural Gas:
- Conventional Drilling and Production
- Enhanced Oil Recovery
- Transportation by Pipeline

Geothermal
- Hot Water and Hot Rock
- Electric Power Generation
- Transportation by EHV

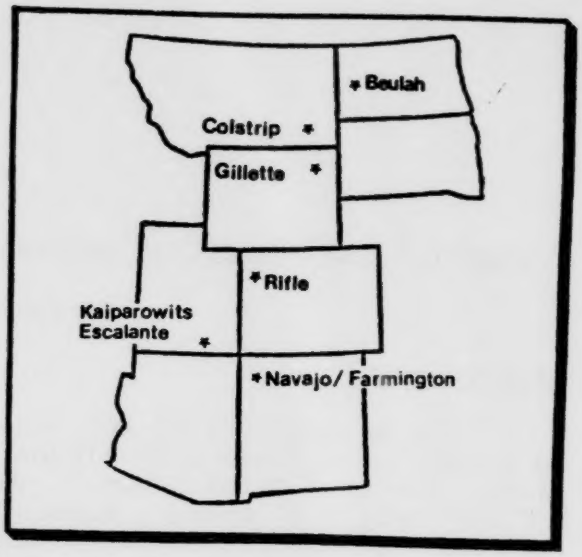

FIGURE 1: THE EIGHT-STATE STUDY AREA AND SIX SITES

Organization

This report is divided into three parts. The purpose of the two chapters in Part I is to describe the national and regional context within which western energy resources are being and will be developed. In the first chapter the overall national policy context is described. In addition to discussing some of the effects of this national context, the second chapter describes major regional factors and considerations which will also help to shape western energy resource development policies.

---

[1] These development alternatives are briefly described in Section 2.3.

CHAPTER 1

THE NATIONAL CONTEXT OF WESTERN ENERGY RESOURCE DEVELOPMENT

1.1 INTRODUCTION

The 1973 Organization of Petroleum Exporting Countries (OPEC) oil embargo shocked the U.S. into recognizing that the days of abundant, cheap energy were over and that being dependent on foreign energy sources can be a significant threat to our national security. Since energy has historically been considered the lifeblood of our highly industrialized, technological society, this realization led to energy immediately becoming a highly visible, high priority public policy problem. Three successive administrations and each Congress since the 93rd have attempted to deal with the complex problems and issues that are involved. Their efforts have been affected by the nature and character of the overall context within which energy policy is being made. Several major factors shape this context:

- After absorbing the initial shock of waiting in long lines at gas stations, paying more for energy, and experiencing interruptions in energy supplies, most Americans still do not believe that there really is an energy crisis.
- Although institutional arrangements affecting energy policymaking have been extensively modified since 1973, these arrangements are still inadequate in some energy policy areas, including arrangements which affect intergovernmental and public-private sector roles and relationships, and those which provide for broadened participation in energy policymaking.
- Existing knowledge about energy and other resources, energy technologies, and the impacts of energy resource development is not adequate to eliminate the uncertainty policymakers often face when making policy choices.
- It has become increasingly obvious that energy problems are inextricably linked with economic and environmental problems and that policies intended to solve problems in one area will affect problems in the other two.

This chapter briefly discusses these factors and generally describes the overall national policy context within which western energy resource policy is being and will be made. In the following chapter, the focus will be narrowed to the West and to those factors and considerations likely to affect the formulation and implementation of western energy resource development policies most significantly.

1.2 PUBLIC ATTITUDES TOWARD ENERGY AS A PUBLIC POLICY PROBLEM

1.2.1 Public Perceptions of Energy as a Public Policy Problem

Since 1974, the Federal Energy Administration (FEA) (and now the Department of Energy [DOE]) has surveyed public attitudes toward the costs and availability of energy.[1] Dr. Jeffrey S. Milstein, Director of Marketing Research in DOE's Office of Conservation and Solar Applications, reports that these surveys have consistently shown that less than one-half of the public believes that the energy shortage is real.[2] A published summary of the results of the March 1974 survey indicates that slightly more than 20 percent of the public believed energy shortages to be serious and long-term at that time.[3] In May 1977, following President Carter's energy message in which he called on the nation to wage the "moral equivalent of war," the percentage of the public taking this position peaked at about 40 percent.[4] The percentage believing that energy is a serious long-term problem has now stabilized at about 30 percent.[5]

---

[1] Opinion Research Corporation. General Public Attitudes and Behavior Toward Energy Saving, prepared for the U.S. Federal Energy Administration (now DOE). Springfield, Va.: National Technical Information Service, monthly beginning in September 1974. (Title varies.)

[2] Milstein, Jeffrey S. "How Consumers Feel About Energy: Attitudes and Behavior During the Winter and Spring of 1976-77." Unpublished paper, June 1977, p. 5. Milstein's paper is not an official statement of either DOE or of the U.S. Government.

[3] Opinion Research Corporation. General Public Attitudes and Behavior Toward Energy Saving, Vol. 1, prepared for the U.S. Federal Energy Administration. Springfield, Va.: National Technical Information Service, September 1974, p. 2.

[4] U.S., President. "Energy Address to the Nation: Broadcast Remarks of President Carter, April 18, 1977," in Bureau of National Affairs. Energy Users Report, Current Report No. 193 (April 21, 1977), pp. 41-43.

[5] Milstein, Jeffrey S. Personal communication.

The FEA/DOE surveys have consistently found that more persons with "some college or more" or who are "environmental activists" have consistently viewed the energy problem as serious and long-term.[1] The difference between the public-at-large and these two groups seems to be explained by a difference in their knowledge of and interest in the problem. According to the results of a May 1977 Gallup survey, slightly less than half the public is even aware that "...the United States must import oil to satisfy its energy demands, and only one-tenth of the public has an accurate idea of how much petroleum the United States does import."[2]

This lack of knowledge, which helps to explain the general public's skepticism, has to be viewed in perspective. Citing a University of Texas survey which found less than half of the adult population to be "functionally competent,"[3] Milstein concludes that "if a large fraction of people are generally unaware of what is happening in the world outside of their personal experience, it is not surprising to find them unaware of the nation's energy policies."[4]

What has happened in energy consumption also helps to explain the public's perceptions about the seriousness of our energy problems. Total annual energy consumption in each of the first three years following the OPEC embargo was below 1973 levels. However, energy consumption is increasing again. Table 1-1 shows that consumption in 1976 was only slightly less than in 1973 and that estimated total consumption in 1977 was the highest it has ever been. Table 1-1 also shows that after two consecutive years in which annual growth rate was negative, the energy consumption growth rate in 1977 was the third highest since 1950.

---

[1] FEA defines environmental activists as "those persons who either belong to an environmental accented organization or have written a letter on an environmental subject to a newspaper, legislator or other government body, or have done both." According to Milstein, these two groups together constitute about 15 percent of the total sample.

[2] Milstein, Jeffrey S. "How Consumers Feel About Energy: Attitudes and Behavior During the Winter and Spring of 1976-77." Unpublished paper, June 1977, p. 5.

[3] _Ibid_. The study surveyed 10,000 people on a variety of topics to determine their level of awareness and knowledge. See University of Texas at Austin. _Adult Functional Competency: A Summary_. Unpublished paper, Austin, Texas, March 1975.

[4] Milstein. "How Consumers Feel About Energy."

TABLE 1-1: U.S. ENERGY CONSUMPTION, 1950-1977

YEAR	TOTAL ENERGY CONSUMPTION (10^{15} Btu's)[a]	AVERAGE ANNUAL GROWTH RATE (percent)
1950	34.0	
1955	39.7	3.1
1960	44.6	2.3
1965	53.3	3.6
1970	67.1	4.8
1971	68.7	2.4
1972	71.9	4.9
1973	74.7	3.6
1974	72.9	-2.4
1975	71.0	-2.5
1976	74.0	4.1
1977[b]	77.6	4.6

Btu = British thermal unit

Source: U.S., Department of the Interior. Energy Perspectives 2. Washington, D.C.: Government Printing Office, 1976.

[a] Total energy consumption is the sum of inputs into the economy of the primary fuels (petroleum, natural gas, and coal, including imports) or their derivatives, plus the generation of hydro and nuclear power, converted to equivalent energy inputs.

[b] Estimated.

As the data in Table 1-2 show, increased consumption has varied considerably among sectors. In 1950, the industrial sector consumed 40 percent of U.S. net energy, but only about one-third in 1975.[1] On the other hand, transportation and household-commercial consumption rose from about 25 percent each to

---

[1] Two factors help to explain industry's behavior since 1973. First, increased energy prices motivate industry to effect energy savings where possible; second, energy price increases affected the economy in numerous ways, including lowering production and, thereby, energy consumption.

TABLE 1-2: U.S. ENERGY CONSUMPTION BY ECONOMIC SECTORS (quadrillion Btu's)[a]

YEAR	HOUSEHOLD AND COMMERCIAL	INDUSTRIAL	NONFUEL USES	TRANSPORTATION	LOSSES[b]	GROSS ENERGY
1950	8.1	11.9	1.0	8.6	4.3	34.0
1960	11.4	14.4	1.5	10.8	6.4	44.6
1970	17.0	19.8	2.9	16.4	11.1	67.1
1971	17.4	19.6	2.8	16.9	11.7	68.7
1972	18.1	20.0	3.1	17.9	12.4	71.9
1973	18.0	20.0	3.2	18.8	13.4	74.7
1974	17.6	20.2	3.2	18.3	13.6	72.9
1975	17.3	19.0	3.1	18.4	13.6	71.1
1976	18.8	21.2	NA	19.3	14.4	74.0

Btu = British thermal unit NA = Not available

Source: U.S., Congress, House, Committee on Interstate and Foreign Commerce, Subcommittee on Energy and Power; and Senate, Committee on Energy and Natural Resources and the National Ocean Policy Study of the Committee on Commerce. Project Interdependence: U.S. and World Energy Outlook Through 1990, Committee Print. Washington, D.C.: Government Printing Office, 1977, p. 114.

[a] Lines may not add due to rounding.

[b] Losses are primarily due to conversion inefficiencies, for example, the loss which occurs when coal is converted into electricity.

one-third during the same period.[1] The data for the period since 1973 show that if they changed their consumption habits at all since the 1973 embargo, most Americans apparently changed for only a short time and only slightly. In fact, except for experiencing the initial shortages that followed the embargo and feeling the effects of an occasional inadequate energy supply in some parts of the country, such as during periods of severe weather, consumers have been able to obtain all the energy they want. Of course, they have had to pay higher prices for it--and the FEA/DOE surveys show that they are very concerned about this.[2]

---

[1] U.S., Congress, House, Committee on Interstate and Foreign Commerce, Subcommittee on Energy and Power; and Senate, Committee on Energy and Natural Resources and the National Ocean Policy Study of the Committee on Commerce. Project Interdependence: U.S. and World Energy Outlook Through 1990, Committee Print. Washington, D.C.: Government Printing Office, 1977, p. 114.

[2] Milstein, Jeffrey S. "How Consumers Feel About Energy: Attitudes and Behavior During the Winter and Spring of 1976-77." Unpublished paper, June 1977.

TABLE 1-3: PUBLIC ATTITUDES CONCERNING WHO CAUSED AND IS RESPONSIBLE FOR ENERGY SHORTAGES (percent)

SERIOUSNESS OF THE SHORTAGE	MOST RESPONSIBLE FOR THE SHORTAGE			NATURE OF THE SHORTAGE		
	OIL BUSINESS	PUBLIC/ EVERYONE	GOVERNMENT	REAL	CONTRIVED	BOTH
Very Serious	22	23	17	51	26	16
Somewhat Serious	33	25	19	38	30	27
Not at all Serious	57	5	35	7	78	9

Source: Opinion Research Corporation. General Public Attitudes and Behavior Toward Energy Saving, Vol. I, prepared for the U.S. Federal Administration. Springfield, Va.: National Technical Information Service, September, 1974, p. 5. The more detailed data breaking down the responses to individual questions are not available.

The 1974 FEA survey of public attitudes showed that the public was just about evenly divided on whether the energy shortage was real or contrived.[1] As shown in Table 1-3, there was a high correlation between those who believed that the shortage was "contrived" and "not very serious." The table also reveals a generally high degree of skepticism about the oil industry--and government.[2] This skepticism has undoubtedly been reinforced by the failure of most consumers to experience any energy supply problems. In fact, what they hear about or experience is an international oil glut[1] and a gasoline surplus.[2] It is difficult, therefore, for most Americans to believe that there really is an energy crisis, an attitude which is reinforced by their perception of the way the problem is being dealt with by government.

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[1] Opinion Research Corporation. General Public Attitudes and Behavior Toward Energy Saving, Vol. I, prepared for the U.S. Federal Energy Administration. Springfield, Va.: National Technical Information Service, September 1974, p. 5.

[2] Milstein reports that the results of the FEA/DOE survey consistently show that about one-third to one-half of the public believe that the oil and gas industry is trying to rip them off. Personal communication.

1.2.2 The Effects of Public Attitudes on Energy Policymaking

Given these public attitudes, the Administration and the Congress find it difficult to respond to energy as a public policy crisis. In the absence of a clear public demand that energy problems be dealt with as though they are serious and long-term, it is difficult for policymakers to propose and enact policies that promise to deal effectively with the root causes of our energy problems. It is not obvious that such policies are politically feasible. And at the present time, the Administration and the Congress's estimate of what is publicly responsive and politically achievable is conditioned by the fact that most Americans do not believe that energy is a serious long-term public problem.

In this kind of policy environment, policymakers have tended historically to opt for policies which maintain things as they are or which are expected to produce only small remedial changes. At the present time this kind of response in energy policymaking generally works to the advantage of the energy industry. Although participation in energy policymaking has broadened to include a range of interested parties such as environmentalists and consumers, the energy industry as a whole has a comparatively unambiguous, obvious, and direct stake in energy policymaking.[3] And even though it is not monolithic, industry is generally better organized and can mobilize more resources to influence policymaking than can other interested parties.[1]

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[1] See, for example, "Now an Oil Glut." Newsweek, September 19, 1977, pp. 86-87; "Guess What? We've Got an 'Oil Glut.'" Dun's Review, September 1977, pp. 58-60; and "Why Oil Refiners are 'Drowning' in Crude." Business Week, August 15, 1977, pp. 37-38.

[2] "U.S. Gasoline Sales Up, But Majors' Share Slips." Oil and Gas Journal, Vol. 75 (June 20, 1977), pp. 29-31. Gasoline demand in 1977 set new records, a daily average during the first nine months of 7.1 million barrels per day as compared to 6.7 million in 1973. See U.S., Department of Energy, Energy Information Administration, National Energy Information Center. "Motor Gasoline." Monthly Energy Review, November 1977, p. 10.

[3] See Kash, Don E., et al. Energy Under the Oceans: A Technology Assessment of Offshore Oil and Gas Operations. Norman, Okla.: University of Oklahoma Press, 1973, pp. 107-11; and Lindblom, Charles. Politics and Markets. New York, N.Y.: Basic Books, 1977.

As noted earlier, the FEA/DOE surveys have consistently revealed a public skepticism about the oil industry. This skepticism was reflected in the Congress where some members were clearly suspicious of the industry and the extent to which it was responsible for and would benefit from the energy crisis.[2] When it was learned that the oil industry's 1973 profits were almost 50 percent higher than in 1972 and even higher in 1974, this suspicion and skepticism was heightened.[3]

The public and Congress's skepticism helps to explain the Congress's subsequent elimination of the depletion allowance and the close vote on a bill that would have forced the break-up of vertically integrated energy companies.[4] But over the long-term, industry benefits both from advantages it possesses as a participant in public policymaking and the existing policy environment. This helps explain why industry-supported positions have fared so well in the Congress. Industry typically supports market solutions rather than regulation and taxation. This often puts industry in the posture of opposing many policy initiatives proposed by the Administration and introduced into the Congress. This has been the case with many provisions of the President's National Energy Plan (NEP), for example, with the plan's proposals for gas guzzler taxes, standby gasoline taxes,[5] and the extension of pricing controls.[6] In the present policy context, it is easier for policymakers to be responsive to industry's negative demands, than to advocates of policies which would result in significant changes.

Another factor in the policy environment goes largely unnoticed at the present time but is likely to be important in the future. This factor is that a majority of Americans are very concerned about the increasing cost of energy, a consistent finding of the FEA/DOE surveys mentioned earlier. This concern has not yet been translated into a strong, persistent demand that proposed solutions to our energy problems include an effort to keep energy prices down. The fact is, of course, that energy prices are likely to continue to increase. And major policy proposals, including the NEP, call for using increased prices to decrease consumption. But it seems likely that policymakers will have to deal eventually with their constituents' demand that energy not consume so large a portion of their income.

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[1] See Kash, Don E., et al. Energy Under the Oceans: A Technology Assessment of Offshore Oil and Gas Operations. Norman, Okla.: University of Oklahoma Press, 1973, Chapter 5.

[2] Congressional Quarterly, Inc. Congress and the Nation, Vol. IV: 1973-1976. Washington, D.C.: Congressional Quarterly, 1977, p. 203.

[3] Ibid.

[4] Ibid.

[5] See "Who's Who in the Lobby." Newsweek, June 27, 1977, pp. 18-21.

[6] This is not to say that industry is the only interest which has opposed the NEP. Consumer groups, environmentalists, labor unions, and many others have opposed at least some provisions.

This discussion points up the dilemma which policymakers often face, having to choose between policies which are politically achievable and ones which promise to resolve problems most effectively. While these may be the same policies, they often are not. And both kinds of choices are speculative. That is, it is not always clear that what policymakers decide is politically achievable is the "best" actually achievable. And it is almost never possible to know with complete confidence that a policy choice will effectively solve a problem. Both public confidence and the confidence of policymakers is affected by just how speculative these kinds of choices are. The point to be stressed with regard to energy policymaking at the present time is that a major factor affecting the Administration and the Congress's estimate of what is publicly responsive and politically achievable is conditioned by the fact that most of their constitutents do not believe that energy is a serious long-term public problem.

1.3 INSTITUTIONAL ARRANGEMENTS FOR ENERGY POLICYMAKING

One response that both the Administration and the Congress have made since energy became an important public policy problem has been to modify the institutional arrangements for energy policymaking that existed in 1973. Within the federal government this has included establishing new energy research and development (R&D) and policy agencies, and, eventually, a new cabinet department. In the Congress, committees have been renamed and restructured to focus more attention on energy and natural resources. Intergovernmental and public-private sector relations have also been modified; and the demands of a range of interested parties to participate in energy policymaking have to some extent been accommodated.

1.3.1 Intragovernmental

Major intragovernmental changes occurred in 1974 when most federal energy R&D programs were combined in a single agency, the Energy Research and Development Administration (ERDA) and a new energy policy agency, FEA, was established. Together with the Federal Power Commission (FPC) and several components drawn from other agencies, these two have now combined to create DOE. This new department, which was established late in 1977, is still in the throes of working out many of the problems that seem inevitable when a major new agency is established.[1] In this case these include, for example, how to be both rational and fair in combining ERDA and FEA personnel and programs. DOE also inherited several major unresolved problems from its predecessors, including learning how to be effective in managing large-scale government R&D programs in an area previously left largely to the private sector.[2] A major aspect of this problem remaining unresolved is how to insure that energy technologies developed in government R&D programs get commercially deployed by the energy industry.[3]

Another unresolved intragovernmental problem is the overlapping jurisdiction of agencies. For example, as will be discussed in Section 1.5, energy, economic, and environmental policies and programs are inherently interdependent and interrelated. There have been efforts to deal with some of the problems which occur because of this; for example, there is an active Interagency Energy-Environment Research and Development Program. But the problem persists. In fact, the Congress is currently considering an Office of Management and Budget proposal to transfer energy environmental control R&D from the Environmental Protection Agency (EPA) to DOE and health effects R&D from DOE to EPA. Even more basic is a proposal to establish a Department of Natural Resources as a way of consolidating functions, programs, and responsibilities now spread among several agencies.

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[1] Corrigan, Richard. "The Department of Energy's Continuing, Confusing Shake-Down." National Journal, Vol. 10 (February 4, 1978), pp. 184-87.

[2] In fiscal 1974, the Administration's energy R&D request was a little less than $1 billion. The request for fiscal 1975 was almost twice that; and the Administration requested $3.2 billion for fiscal 1978 and has requested $3.3 billion for fiscal 1979. See Barfield, Claude E. "Science and Energy." National Journal Reports, Vol. 6 (February 9, 1974), pp. 202-05; and Hammond, Allen L. "Carter Budget Tilts 'Back to Basics' for Research." Science, Vol. 199 (February 3, 1978), pp. 507-10.

[3] See House, Peter W., and David W. Jones, Jr. Getting It Off The Shelf: A Methodology for Implementing Federal Research. Boulder, Colo.: Westview Press, 1977; and Hamilton, Mary R. "Energy Policy and Changing Public-Private Relations." Policy Studies Journal, Vol. 7 (Autumn 1978); and Hamilton, Mary R. "Considerations in the Development of a Preliminary Plan for Federal Government Involvement in the Commercialization of Photovoltaics," Chapter VI in BDM Corporation. Draft Interim Report for the Program to Develop a Preliminary Implementation Plan for the Federal Photovoltaic Utilization Program and a Preliminary Commercialization Plan for Photovoltaics. McLean, Va.: BDM Corporation, January 20, 1978.

1.3.2 Intergovernmental

Intergovernmental relations have also been significantly affected since energy became an important public problem, especially relationships between the federal government and the states. The states have traditionally established policies in such areas as energy facility siting and the regulation of public utilities. Although they retain a major role in some policy areas such as siting, states' role in energy has tended to diminish as the federal government has become a more active participant in the energy policy area, including, for example, setting prices on new intrastate natural gas, something that had previously been left to the states.

Although they have had major responsibilities for implementing federal programs such as fuel allocations and the 55 mile-per-hour speed limit, the states have generally had a minor role in the formulation of energy policies. For example, the states still have a relatively minor role in making policies concerning the development of publicly-owned resources such as offshore oil and gas and the large amounts of oil shale, coal, and other energy resources located in western states. And the NEP[1] gives the states a limited role in energy policymaking, primarily restricting this role to information gathering and fuel allocation.[2] Some states are seeking a larger role, particularly the coastal and western states most directly affected by federal policies for developing publicly-owned energy resources.

States have been encouraged to develop and implement energy conservation plans for reducing energy consumption.[3] Under the "Weatherization for Low-Income Groups" provisions of the Energy Conservation and Production Act,[4] local governments or community action agencies may carry out weatherization (primarily insulation) projects. However, state and local government participation in federal conservation programs is voluntary.

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[1] U.S., Executive Office of the President, Energy Policy and Planning. The National Energy Plan. Washington, D.C.: Government Printing Office, 1977.

[2] See U.S., Congress, Office of Technology Assessment. Analysis of the Proposed National Energy Plan. Washington, D.C.: Government Printing Office, 1977, pp. 174-87.

[3] See the Energy Policy and Conservation Act, Pub. L. 94-163, 89 Stat. 871.

[4] See the Energy Conservation and Production Act, Pub. L. 94-385, 90 Stat. 1125, as amended by Pub. L. 95-70, 91 Stat. 275.

1.3.3 Public-Private Sector Relationships

Public-private sector relationships in energy policymaking are also in transition. With the exceptions noted earlier, energy was largely a private sector concern until the early 1970's. This has now changed and government has become a major participant in energy policymaking. In addition to its large-scale energy R&D programs, government now controls prices, surface mine reclamation, the choice of fuels for electric power and industrial facilities, and the installation of environmental control technologies.

Prior to 1973, while energy was still largely a private sector concern, few institutional arrangements structured public-private sector relationships. The most fully developed of those that did exist regulated natural monopolies (the FPC), promoted the development and deployment of nuclear power technologies (the Atomic Energy Commission) and conducted or supported relatively small scale energy R&D (the Bureau of Mines). Otherwise public-private sector relationships tended to follow the pattern of energy policymaking. That is, they tended to be structured around a particular energy resource such as coal, oil, or natural gas.

Government's greatly expanded, much more active energy role has changed this. But public-private sector relationships have not yet successfully adapted to this fundamental change. This is most obvious at the national level where, as mentioned earlier, government's energy R&D programs will be effective in achieving their intended objectives only if the private sector accepts and commercially deploys the technologies that these programs develop. There is widespread agreement that cooperation and coordination between the two sectors is an essential requirement if federal programs are to succeed and serious, long-term energy problems are to be resolved.[1] At the national level this cooperation and coordination must begin with the initiation of an R&D program and continue through successful commercialization of the technologies.

As the discussion in the following chapter will show, the need for effective public-private sector cooperation and coordination can be just as great at the local level as, for example, when energy facilities are being sited and policies and programs to avoid or mitigate adverse impacts are being formulated and implemented. Without the cooperation of the energy developer, a community may not have the information required to formulate such policies and programs until the development is almost ready to begin. These problems will be discussed in more detail in Chapter 2.

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[1] See, for example, Hamilton, Mary R. "Energy Policy and Changing Public-Private Relations," Policy Studies Journal, Vol. 7 (Autumn 1978), pp. 90-96; and Knight, Kenneth E. "Business-Government Relations: Some Key Problems Facing the Federal Government's Energy Programs, 1975-1985," in Minger, Terrell J., and Sherry D. Oaks, eds. Growth Alternatives for the Rocky Mountain West: Papers from the Vail Symposium V. Boulder, Colo.: Westview Press, 1976, pp. 41-72.

1.3.4 Participation in Policymaking

In recent years, in response to the demand of a variety of interests (such as environmental and consumer interest groups), participation in policymaking in most areas of public policy has been expanded to include a range of interested parties who previously had either not participated in policymaking at all or had participated only occasionally. Participation in energy policymaking has been broadened, frequently through mechanisms such as public hearings and procedures for commenting on environmental impact statements (EIS), but also through legal actions brought against a particular proposed energy development such as siting a specific energy facility.

Leaving aside the question of whether the results of this broadened participation have been and are likely to be socially beneficial, the overall effect has been to expand the range of interests that have to be accommodated in the policymaking process. This has inevitably complicated energy policymaking since, whether these interests are accommodated while policy alternatives are being formulated or when an attempt is made to implement them, it generally takes longer to take a broad range of interests into account than it does the interests of a few like-minded participants. For example, prior to about 1970, direct continuous participation in making and implementing outer continental shelf (OCS) oil and gas policies had been largely limited to the petroleum industry and government. Since government and industry had almost identical policy objectives, policymaking and implementation was relatively uncomplicated. But a generally increased concern for the environment and several specific events such as oil spills and oil well blowouts led new participants representing new interests to demand a role in making and implementing OCS policies.[1] As a consequence, changes proposed to the basic legislation governing OCS development have been being debated since about 1973;[2] and the development of OCS resources off the East Coast which was planned to begin in 1975, began only recently.

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[1] Kash, Don E., et al. Energy Under the Oceans: A Technology Assessment of Offshore Oil and Gas Operations. Norman, Okla.: University of Oklahoma Press, 1973, Chapter 5.

[2] See, for example, Congressional Quarterly, Inc. Congress and the Nation, Vol. IV: 1973-1976. Washington, D.C.: Congressional Quarterly, 1977, pp. 252-53, and 279-82.

The case of OCS policymaking is not unique. In many areas of energy policymaking, including the development of western energy resources, the broad range of interests represented in energy policymaking have yet to be accommodated. The implications of this for western energy resource development will be discussed in general in Chapter 2 and in the specific problem and issue categories analyzed in Part II.

1.4 ADEQUATE, RELIABLE, AND CREDIBLE KNOWLEDGE FOR ENERGY POLICYMAKING

Policymakers almost always have to make choices under conditions of uncertainty. But the level of their uncertainty can be quite different depending upon the relative adequacy, reliability, validity, and credibility of the knowledge base available to them. The lack of an adequate, reliable, and credible knowledge base concerning energy resources, energy technologies, and their impacts largely determines the level of confidence that policymakers, other interested parties, and the general public can have in energy policies and programs.[1]

Two examples of resources for which the existing knowledge base is inadequate are uranium and natural gas. Estimates of uranium resources vary significantly. For example, ERDA's 1976 estimate of potential resources was 2.9 million tons at a price of $30 per pound or less; another contemporary nongovernmental estimate is that potential resources are only about one-third that amount. These are only two of the several, often confusing and conflicting estimates.[2]

The situation in natural gas is somewhat the same. A National Academy of Sciences study currently in progress has published results which show that offshore natural gas reserves estimates in three of four fields tested as a part of the study are on the average 40 percent high.[3]

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[1] Kash, Don E., et al. Our Energy Future: The Role of Energy Research, Development, and Demonstration in Reaching a National Consensus on Energy Supply. Norman, Okla.: University of Oklahoma Press, 1976, Chapter 2.

[2] Ibid., pp. 295-96.

[3] The study is being conducted by a National Research Council Committee on Gas Production Opportunities. The four fields tested by the committee's consultants were Tiger Shoal, East Cameron 64, Eugene Island 266, and Vermilion 14. Results of field tests on two other fields, South Marsh Island 48 and East Cameron 271, are similar.

The lack of adequate, reliable, credible knowledge about energy technologies and their impacts is illustrated by the absence of data on most synthetic fuel technologies at a commercial scale. With the exception of Lurgi high-British thermal unit (Btu) gasification, data exist for only bench or pilot scale facilities.[1] The lack of data and experience either handicaps or makes impossible the anticipation and analysis of the impacts or effects that can be expected to occur where these energy technologies are deployed.

If the existing knowledge base is inadequate because of a lack of theoretical understanding, no amount of data will eliminate the high level of uncertainty which policymakers will confront. For example, at the present time, the understanding of how trace elements are chemically bonded in different types of coal and how different chemical bonds will affect what happens when coal is burned in various types of boilers is quite limited. Considerable analytical chemical and bench or pilot scale testing in different kinds of boilers will be required to acquire the empirical knowledge base that may eliminate the knowledge gap and make it possible to predict what will happen when a coal with known characteristics is burned in various kinds of boilers.[2] For example, results of such research would make it possible to predict what portion of the trace elements will be emitted as air and water pollutants.

Problems that are more clearly data problems may be just as difficult for policymakers to deal with. For example, the problem may be the lack of adequate baseline data in the area surrounding a proposed energy development. The data required to identify and analyze the impacts that would likely occur can usually be collected. However, the geographical area for which data would be required may be so large and the time period for which data are needed so long that it is practically impossible to afford, collect, manage, and make the data available when they are needed.

Policymakers frequently have to deal with credibility problems which also involve adequacy and reliability. For example, much of the existing data on energy resources are industry data. The data on natural gas mentioned earlier are, for the most part, either industry data or based on information supplied by industry. Such data can affect policymaking in a variety of ways. Data on natural gas, for example, affect government policies which set wellhead prices. Even when industry makes its data available to government, the data have to be treated as proprietary. This complicates policymaking since consumer and environmental groups, among others, believe that data which industry makes public or furnishes to government are often self-serving, and therefore, totally inappropriate as the basis for informed public policymaking.[1]

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[1] The data for Lurgi are proprietary and, therefore, generally not available to public policymakers.

[2] The characteristics of coal vary considerably, often within the same coal field.

Policymakers are constantly confronted with a dilemma when dealing with the uncertainties associated with making policy choices in the absence of an adequate, reliable, credible knowledge base. As noted earlier, policymakers almost always have to make choices under conditions of uncertainty. At times, the level of uncertainty is so high that they have to decide whether it would be more socially responsible to choose not to do something, or to delay doing something until a test has been conducted, more data collected, and more analysis completed. This is the case in several areas of energy policymaking, as, for example, in the case of government funding or guarantees to support the deployment of the synthetic fuel technologies mentioned earlier and government policies promoting the development and deployment of nuclear technologies which pose significant waste disposal and nuclear safeguards problems. In almost all such cases, policymakers have to deal with participants in the policymaking system who argue that the existing knowledge base is inadequate, unreliable, or not credible. And in many such cases, policymakers are at the same time made to feel a sense of urgency, either as a consequence of their own knowledge about our energy problems or because of the pressure of other participants in energy policymaking.

Of course, it is not only public sector policymakers who have to deal with uncertainty. Private sector policymakers also deal with various uncertainties, not the least of which is related to government policies, for example, environmental control requirements and energy facility siting policies.

1.5 ENERGY, ECONOMICS, AND THE ENVIRONMENT

Each of the factors and considerations discussed briefly above in some way affects or is affected by the pervasive interdependence and interrelatedness of energy, economics, and environment. This interdependence and interrelatedness is perhaps the single most critical category of factors shaping the energy policymaking context both nationally and regionally.

As highly industrialized, technological western societies have evolved, a basic assumption has been that there is a direct correlation between economic growth and human welfare and that economic growth, if not directly dependent upon, is directly related to energy consumption. These assumptions are based on a materialistic definition of human welfare and what constitutes the "good life." That is, the "good life" has historically been defined in the Western world in terms of happiness and material comfort; and it has been assumed that both are achieved by extending man's control over nature, by producing more and more material products. The means to this end has been the acquisition and application of knowledge; in short, the principal means for attaining the "good life" has been through science and technology--which has resulted in western societies becoming increasingly energy-intensive. Although seriously challenged in recent years, it is this logic put into practice which leads to the conclusion, and, at present the condition, that energy is the lifeblood of our highly industrialized, technological society.[1]

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[1] See, for example, Stacks, John F. Stripping. San Francisco, Calif.: Sierra Club, 1972; and Novick, Sheldon. "Special Report: Energy Roundup." Environment, Vol. 19 (June/July 1977), pp. 29-33.

As societal values other than economic growth have received more attention (environmental quality, for example), and as a less materialistic definition of what constitutes the "good life" has become more popular, a variety of energy, economic, and environmental conflicts have arisen. Already underway in 1973, energy, economic, and environmental conflicts have intensified since the embargo and subsequent realization that the days of abundant, cheap energy were effectively over.

The decade preceding the embargo might well be called the decade of the environment. Acceptance of public responsibility for the quality of human environment was acknowledged in the National Environmental Policy Act of 1969.[2] Public attitudes about environmental quality changed significantly during this period. For example, whereas in 1965 only 28 percent of the American public believed air quality and 35 percent water quality to be problems, by 1968 these percentages had increased to 55 and 53 percent respectively.[1] By 1970, the public considered air pollution to be our second most important domestic problem.

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[1] As Rene Dubos, among others, has argued, it has become obvious that the advancement of knowledge doesn't automatically improve the human condition. (See his Reason Awake: Science for Man. New York, N.Y.: Columbia University Press, 1970; and So Human an Animal. New York, N.Y.: Charles Scribner's Sons, 1968.) Others, Barry Commoner, for example, agree with Dubos' general statement. But Commoner also argues that a part of our energy problem is a consequence of the inappropriate uses to which we have put high quality fuels such as electricity and natural gas. Energy analysts of the H.T. Odum or "eco-energetics" school go even further, arguing that our basic energy problems result from not accounting for energy subsidies from the natural environment. (See, for example, Odum and Martha Gilliland in Gilliland, Martha, ed. Energy Analysis: A New Public Policy Tool. Boulder, Colo.: Westview Press, 1978; and Nicholson, Jean Martin. "The Three E's: Economics, Energy, and Environment." EPA Journal, November-December 1977, pp. 16-18.)

[2] See National Environmental Policy Act of 1969. Pub. L. 91-190, 83 Stat. 852; and Caldwell, Lynton Keith. Environment: A Challenge to Modern Society. Garden City, N.Y.: Anchor Books, Doubleday, 1970.

While a clear causal relationship cannot be established, it seems likely that a number of environmental catastrophes involving either energy production or transportation contributed to this change in public attitudes. For example, the Torrey Canyon accident in the English Channel and Union Oil's blowout in the Santa Barbara Channel were given extensive coverage by the news media, thereby focusing the public's attention on the undesirable consequences of large oil spills. Coupled with the kinds of highly visible air and water quality problems which were becoming increasingly obvious to everyone, a majority of the public became convinced that many environmental problems were serious.[2] Given this kind of policy context, these problems received priority attention. Major environmental legislation was passed (for example, air and water quality acts), new institutions were established (for example, EPA and the President's Council on Environmental Quality), mechanisms for expanded public participation in public policymaking were established (for example, in the EIS process and Corps of Engineers hearings), new intergovernmental relationships were developed (for example, state and federal relationships in air and water quality),[3] and public-private sector relationships were significantly altered (for example, a range of governmental interventions requiring industry to acquire permits to do many things that previously had often been unregulated such as obtaining air and water pollutant discharge permits).

As indicated earlier, prior to the embargo, Americans had enjoyed an abundance of cheap energy. One of the most basic changes which occurred following the embargo was a dramatic increase in energy costs, in large part due to the almost 400 percent increase in the cost of foreign oil--from $3.00 per barrel on October 1, 1973 to $11.65 on January 1, 1974.[4] Purchasing power and industrial output both dropped, unemployment rose, and inflation accelerated. In short, the economic impacts were severe.[1] The Nixon Administration's most significant policy response was to propose a "Project Independence" to achieve energy self-sufficiency.[2] As now articulated, our national energy policy objective is to achieve independence from insecure foreign sources--it had been clear to most analysts from the outset that "zero imports" were neither possible nor desirable. In practice, current policy seems aimed at reducing impacts to a more economically acceptable level.

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[1] As reported in Jones, Charles O. Clean Air: The Policies and Politics of Pollution Control. Pittsburgh, Pa.: University of Pittsburgh Press, 1975, pp. 144-46.

[2] See Chapter V and Appendix A of Kash, Don E., et al. Energy Under the Oceans: A Technology Assessment of Offshore Oil and Gas Operations. Norman, Okla.: University of Oklahoma Press, 1973.

[3] See Chapters 5 and 6 in Part II.

[4] Congressional Quarterly, Inc. Congress and the Nation, Vol. IV: 1973-1976. Washington, D.C.: Congressional Quarterly, 1977, p. 201.

The two major elements of energy policies intended to contribute to achieving independence from insecure foreign sources have been technological fixes and conservation. The institutional changes mentioned in Section 2.3 reflect the heavy emphasis on the technological fix approach. That is, policies and programs have emphasized dealing with energy supply problems by developing new technologies which tap previously untapped or largely untapped resources (for example, the sun and ocean thermal gradients) or convert resources such as coal and oil shale into fuel forms which are more compatible with our existing system for distributing and utilizing energy (gases and liquids, for example). Although the emphasis on replacing imported oil with domestic resources combines both technological fixes and conservation, the former are generally more politically attractive since they promise to reduce the need for policymakers to make choices which they believe would require their constituents to undergo significant lifestyle changes.

The economic impact of these energy policies can be enormous. Despite a generally agreed upon national energy policy aimed at lessening our dependence on energy imports, in 1977 imports accounted for almost 50 percent of our oil supply, an increase of approximately 35 percent over 1973.[3] Payments for oil imports have also increased, from $2.5 billion in 1973 to $31.8 billion in 1976.[4] And the balance of payments effect has been staggering;

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[1] Congressional Quarterly, Inc. Congress and the Nation, Vol. IV: 1973-1976. Washington, D.C.: Congressional Quarterly, 1977, p. 201.

[2] U.S., Federal Energy Administration. Project Independence Report. Washington, D.C.: Government Printing Office, 1974.

[3] Corrigan, Richard, Dick Kirschten, and Robert Samuelson. "Jimmy Carter's Energy Crusade." National Journal, Vol. 9 (April 30, 1977), p. 660.

[4] U.S., Department of Commerce. Survey of Current Business, November 1977, pp. S-22 and S-23.

the deficit due to oil imports is presently $27 billion[1] in comparison to a surplus of $4.2 billion in 1973.[2] One consequence of this increase has been to destabilize the dollar in foreign exchange markets; some analysts go so far as to suggest that we are on a path leading to national bankruptcy.[3]

At the present time the per barrel price of oil is the yardstick against which all energy prices have to be measured. Since this is an artificial price set by the OPEC cartel, developing domestic alternatives which have a high production cost can be quite a risky undertaking. For example, if the cartel were to reduce its high per barrel price of oil to a less artificial level, most synfuels and advanced technologies would be priced out of the market. This is hardly an attractive prospect to private sector investors and, in fact, most commercial scale synfuels projects have yet to be implemented. To date, efforts to provide some kind of government program which would lessen the private sector's risk, (for example, guarantees and insurance) have been unsuccessful. As the discussion in Chapter 2 will show, this energy-economics interface has and will significantly affect the development of western energy resources.

Reducing imports by switching to domestic supply sources will affect the environment as well as the economy. For example, federal emissions and ambient air regulations established before the embargo increased the attractiveness of clean fuels such as natural gas and led many utilities and industrial plants to switch from other fuels, particularly high sulfur coal. The Carter Administration's fuel switching program will require many of these consumers to switch back to coal. Even with sulfur dioxide scrubbers and electrostatic precipitators, this conversion will affect air quality. The apparent economic costs of the switch are also obvious. That is, the total cost will now include the capital investment required for the original conversion, the reconversion, and the installation of environmental controls that weren't necessary when clean fuels were being burned.

Policymakers are understandably confused when they have to deal with problems such as these which illustrate that all problems and solutions seem to be interdependent and interrelated.

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[1] "The Reluctant Exporter." Business Week, April 10, 1978, p. 54.

[2] Department of Commerce. Survey of Current Business, November 1977, pp. S-22 and S-23.

[3] "Propping the Dollar at Last." Time, January 16, 1978, p. 40. The Treasury Department recently announced a new program intended to stabilize the dollar, a periodic auction of gold from Fort Knox. See Wall Street Journal, April 20, 1978, p. 1.

They find that an attempt to deal with a problem at one point in the system produces problems somewhere else. The proposals they are offered are often contradictory and are challenged by other participants in energy policymaking. Since energy, economics, and environmental problems are so obviously interdependent and interrelated in numerous ways, attempting to resolve our serious, long-term energy problems is enormously complicated both nationally and regionally.

1.6 SUMMARY

This brief discussion demonstrates the complexity of the policy context within which western energy resource development is and will take place. As noted above, public attitudes and the adequacy of existing institutional arrangements and knowledge base help to shape this overall national policy context. But it is interdependencies and interrelationships among national energy, economic, and environmental problems, policies, and programs which appear to be most pervasive in shaping the context within which energy policies are being made, including western energy resource development policies. In the following chapter, the likely effects of both national and state policies as well as regional factors and considerations on western energy resource development will be discussed.

CHAPTER 2

THE REGIONAL CONTEXT OF WESTERN ENERGY RESOURCE DEVELOPMENT

2.1 INTRODUCTION

Western energy resource development is and will be affected by regional factors as well as by the overall national policy context described in Chapter 1. Among the most important of these regional characteristics are such things as: natural resources, population and population patterns, sectors of economic activity, industrial development, lifestyle, and values; regional attitudes toward energy development; the likely effects of national and state policies on how much of each of the six resources will be developed, and which technologies will be used to develop them over what time period; and public-private sector and intergovernmental relationships. Each of these will be briefly discussed in this chapter.

2.2 AN OVERALL CHARACTERIZATION OF THE EIGHT-STATE STUDY AREA[1]

Among the regional factors and considerations that affect western energy development, none is more important than the general nature and character of the region. In general, the eight-state study area has the following characteristics:

- Except for water it is rich in natural resources.
- With the exception of several large metropolitan areas (Albuquerque, Denver, Phoenix, Salt Lake City, and Tucson), it is sparsely populated.
- Much of the land and many of the mineral rights are owned by the federal government and Indian tribes.
- Agriculture, mining, tourism, and government service are the major sectors of economic activity. Manufacturing employs more than 10 percent of the labor force in only three states: Arizona, Colorado, and Utah.

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[1] This brief description of the eight-state study area is a summary of our impressions which have been derived from published materials, personal communications, and field research.

- Rugged individualism is still highly valued and government intervention is generally strongly opposed.

- Attitudes toward energy resource development range widely from being strongly supportive to strongly opposed.

In the remainder of this section, each of these characteristics will be discussed briefly to provide a broad-brushed, overall description of the study area.

2.2.1 Natural Resources

The natural resources of the area are quite diverse and include a variety of plant and animal, scenic and aesthetic, mineral, and recreation resources. Many of these resources have been set aside by the federal government as Indian reservations, national forests, parks, recreation, historic, and wilderness areas. Large amounts of energy and other mineral resources in the eight-state study area underlie federal and Indian owned lands.

A. Water Resources

The principal exception to the overall resource-rich character of the West is water. The two major river basins in the eight-state study area are the Colorado and the Upper Missouri. Estimated average instream flow for the Colorado River ranges from 15.5 million to 16.2 million acre-feet per year (acre-ft/yr); the most commonly used estimate is 13.5 million to 14.0 million acre-ft/yr.[1] Annual stream flow estimates for the Upper Missouri range from 12.5 million to 21.8 million acre-feet.[2]

Current water consumption in the Upper Colorado is approximately 3.5 million acre-ft/yr. Existing interstate compacts obligate Upper Colorado Basin states to provide 7.5 million acre-ft/yr to the Lower Basin.[1] If Upper Basin states are assumed to be obligated to supply one-half of the 1.5 million acre-ft/yr obligated to Mexico by the Mexican Water Treaty of 1944, an obligation they do not accept,[2] the quantity of water which must be delivered to the Lower Basin each year is 8.25 million acre-feet. Given the above stream flow, consumption estimates, and uncertainties about the obligation to Mexico, this would seem to leave from 1.75 to 3.5 million acre-ft/yr for future increases in water use in the Upper Colorado River Basin (UCRB). This is somewhat misleading, however, since this much or more has already been allocated but is not being used at the present time.[3]

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[1] See Plotkin, Steven E., Harris Gold, and Irvin L. White. "Water and Energy in the Western Coal Lands." Water Resources Bulletin, Vol. 15 (February 1979) for details on surface water estimates and possible shortages.

[2] See White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Chapter 12, for a description of surface and groundwater resources in the study area.

The picture in the Upper Missouri is somewhat different. An estimated 19 million acre-ft/yr is the practical limit for depletions above Sioux City, Iowa.[4] Current depletions above this point are about 6.5 million acre-ft/yr which leaves up to 13.5 million acre-ft/yr for future uses including energy development. However, as with availability in the Upper Colorado, this is somewhat misleading because of existing allocations and, in this case, the location of surface waters in relation to energy resources.[5]

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[1] More precisely, the 1922 Compact (Colorado River Compact of 1922, 42 Stat. 171, 45 Stat. 1064, declared effective by Presidential Proclamation, 46 Stat. 3000 [1928]), guarantees 75 million acre-feet over each consecutive 10 year period. See Chapter 4 and Plotkin, Steven E., Harris Gold, and Irvin L. White. "Water and Energy in the Western Coal Lands." Water Resources Bulletin, Vol. 15 (February 1979).

[2] In a letter to Mr. Harl Noble, Acting Director, Upper Colorado Region, Bureau of Reclamation, Governor Richard D. Lamm of Colorado, states that "in view of the almost indisputable evidence at this time, the state of Colorado must insist by all means available to it, that Colorado and the other Upper Basin states must not currently or in the foreseeable future be charged with a Mexican Treaty deficiency." See Chapter 4.

[3] In addition to overallocations in at least some of the states, uncertainties concerning water availability are affected by unquantified federal and Indian water rights. See Chapter 4 for a discussion of these rights and the potential effects of quantification.

[4] U.S., Department of the Interior, Water for Energy Management Team. Report on Water for Energy in the Northern Great Plains Area With Emphasis on the Yellowstone River Basin. Denver, Colo.: Department of the Interior, 1975, p. VII-6.

[5] For details see Chapter 4 below.

Groundwater resources are being utilized in some parts of the eight-state area; in fact, in some areas such as southern Arizona, groundwater resources are currently being overutilized. Large quantities of groundwater are known to exist in certain areas, such as in Wyoming, where they are not currently being used on a large scale. Overall, however, existing knowledge about groundwater, its quality in relation to how it might be used, and its location in relation to where it might be needed is somewhat limited.

B. Energy Resources

The quantities of the six energy resources being considered are shown in Table 2-1 and their general distribution in the eight-state study area in Figure 2-1. Coal and oil shale are the most abundant among the six. In fact, approximately 36 percent of all U.S. coal is located in the study area, virtually all the nation's high grade oil shale is located in the Green River Formation in western Colorado, Utah, and Wyoming; and almost all of the nation's high grade uranium ore is located in the eight states, primarily in New Mexico and Wyoming.

As shown in Table 2-2, the federal government and Indians own almost 45 percent of the total land in the eight-state study area. Together, the federal government and Indians own more than half the land in Arizona, Utah, and Wyoming and more than a third in Colorado, Montana, and New Mexico.

Data on resource ownership are more difficult to obtain. However, it appears that the federal government owns about half the coal, geothermal, and uranium, and about 80 percent of the oil shale resources in the eight-state area. The 271 Indian reservations in the U.S. are estimated to contain from 10 to 16 percent of the nation's coal reserve[1] and one-third of all lands held for uranium exploration and development. Most of these resources are located on a few of the approximately fifty Indian reservations located in our study area.[2] For example, Indian lands in Colorado, New Mexico, and Wyoming account for 45 percent of all lands held for uranium exploration and development in

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[1] Crittenden, Ann. "Coal: The Last Chance for the Crow." New York Times, January 8, 1978, Section 3, p. 1.

[2] See U.S., Federal Trade Commission, Bureau of Competition. Report to the Federal Trade Commission on Mineral Leasing on Indian Lands. Washington, D.C.: Federal Trade Commission, 1975.

TABLE 2-1: PROVEN RESERVES OF SIX ENERGY RESOURCES IN THE EIGHT-STATE STUDY AREA

RESOURCE	WESTERN RESERVES (10^{15} Btu's)	PERCENT OF U.S. TOTAL RESERVES
Coal[a]	3430.0	35.9
Crude Oil[b]	12.2	6.4
Natural Gas[c]	19.9	7.8
Oil Shale[d]	464.0	≈100.0
Uranium[e]	246.6	90.6
Geothermal[f]	650.0	22.1

≈ = approximately

[a] Hamilton, Patrick A., D.H. White, Jr., and Thomas K. Matson. The Reserve Base of U.S. Coals by Sulfur Content, Part 2: The Western States, Information Circular 8693. Washington, D.C.: U.S., Department of the Interior, Bureau of Mines, 1975, p. 7 and Table D, pp. 282-322; and Parker, N.A., and B.C. Thompson. U.S. Coal Resources and Reserves. Washington, D.C.: U.S., Federal Energy Administration, 1976, p. 3. Reserves include identified coal resources that can be economically and legally mined at the time of determination. For conversion to British thermal units (Btu's) the national average heat content was assumed to be 11,000 Btu's per pound of coal (calculated from data in U.S., Congress, House of Representatives, Committee on Science and Technology, Subcommittee on Energy Research, Development, and Demonstration. Energy Facts II, Committee Print, by Library of Congress, Congressional Research Service, Science Policy Research Division. Washington, D.C.: Government Printing Office, 1975) and the eight-state average heat content was assumed to be 8,500 Btu's per pound (Cazalit, Edward, et al. A Western Regional Energy Development Study: Economics. Menlo Park, Calif.: Stanford Research Institute, 1976, Vol. II, p. X-26).

[b] Bureau of National Affairs. "Proved Crude Oil Reserves: American Petroleum Institute, Data for 1976." Energy Users' Report, Reference File, p. 81:0623 (September 29, 1977). Reserves include economically recoverable petroleum in identified geologic deposits. A heat content of 5.8 million Btu's per barrel of oil was assumed (U.S., Library of Congress, Congressional Research Service. In Bureau of National Affairs. "Energy Conversion Factors. Energy Users' Report, Reference File, p. 01:0062 [November 28, 1974]).

[c] Bureau of National Affairs. "Estimated Total Proved Reserves of Natural Gas in the U.S. (statistical tables were provided by the American Gas Association and released in April 1977)." Energy Users' Report, Reference File, p. 81:0601 (September 29, 1977). Reserves include economically recoverable natural gas in identified reservoirs. A heat content of 1,000 Btu's per cubic foot of gas was assumed (U.S., Library of Congress, Congressional Research Service. In Bureau of National Affairs. "Energy Conversion Factors," Reference File, p. 01:0062 [November 28, 1974]).

TABLE 2-1: (Continued)

[d] U.S., Congress, Senate, Committee on Energy and Natural Resources, Subcommittee on Energy Research and Development. Petroleum Industry Involvement in Alternative Sources of Energy, Committee Print. Washington, D.C.: Government Printing Office, 1977, pp. 154 and 169. Reserves include only known high-grade (25-100 gallons per ton) reserves recoverable under present conditions. It was assumed that shale oil is equivalent to crude oil in heat content; and 5.8 million Btu's per barrel was used as the basis for conversion.

[e] U.S., Energy Research and Development Administration, Grand Junction Office. Statistical Data of the Uranium Industry, GJO-100(77). Grand Junction, Colo.: Energy Research and Development Administration, 1977, p. 61. Reserves include known uranium deposits which can be exploited at a cost of $30 per pound of uranium oxide (U_3O_8) or less. Latest cost estimates indicate, however, that $50 per pound is a more likely cost figure. The heat content was evaluated in relationship to the lightwater reactor and was assumed to be four hundred billion Btu's per ton of U_3O_8 (U.S., Congress, House of Representatives, Committee on Science and Technology, Subcommittee on Energy Research, Development, and Demonstration. Energy Facts II, Committee Print, by Library of Congress, Congressional Research Service, Science Policy Research Division, 1975, p. 24).

[f] Renner, J.L., D.E. White, and D.L. Williams. "Hydrothermal Convection Systems," in White, D.E., and D.L. Williams, eds. Assessment of Geothermal Resources of the United States--1975, Geological Survey Circular 726. Reston, Va.: U.S., Department of the Interior, Geological Survey, 1975. Resources include not only reserves (identified sources), but also submarginal (recoverable only at a cost that is more than twice the current price of competitive energy systems) and paramarginal (recoverable at between one and two times the current price of competitive energy) resources in identified hydrothermal convection systems. In addition, an estimated 260,000 X 10^{15} Btu's of hot dry rock geothermal resources may be economically exploitable in the U.S. No estimate has yet been made of the amount of hot dry rock resources in the eight-state area. (See Los Alamos Scientific Laboratory, HDR Project Staff. Hot Dry Rock Geothermal Energy Development Project, Annual Report, Fiscal Year 1977. Washington, D.C.: U.S., Department of Energy, 1978, p. 19.) For conversion to Btu's from calories, it was assumed that 10^{18} calories was equivalent to the heat of combustion of ≈690 million barrels of petroleum or ≈154 million short tons of coal. (See White, D.E., and D.L. Williams. "Summary and Conclusions," in White and Williams. Geothermal Resources, p. 148.)

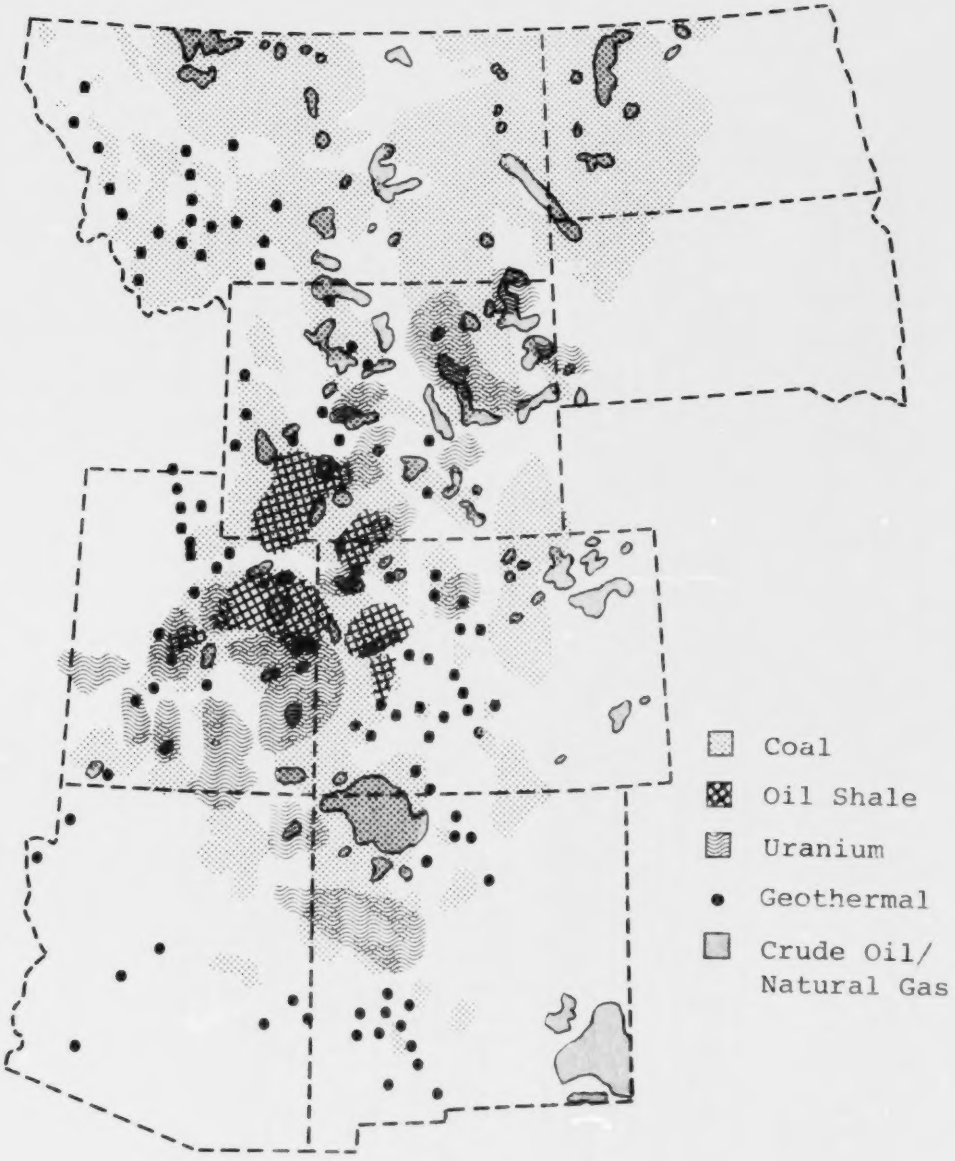
Coal
Oil Shale
Uranium
Geothermal
Crude Oil/
Natural Gas

FIGURE 2-1: GENERAL DISTRIBUTION OF COAL, CRUDE OIL? NATURAL GAS, GEOTHERMAL, OIL SHALE, AND URANIUM RESOURCES IN EIGHT WESTERN STATES

TABLE 2-2: FEDERAL AND INDIAN LANDS IN THE EIGHT-STATE STUDY AREA

STATE	TOTAL AREA (thousands of acres)	PERCENT FEDERAL	PERCENT INDIAN	PERCENT FEDERAL AND INDIAN
Arizona	72,688	43	29	72
Utah	52,697	66	4	70
Wyoming	62,343	48	3	51
New Mexico	77,766	34	8	42
Colorado	66,486	36	1	37
Montana	93,271	30	6	36
South Dakota	48,882	7	12	19
North Dakota	44,452	5	5	10
Total	518,585	35	9	44

Sources: U.S., Department of the Interior, Bureau of Land Management. Public Land Statistics 1976. Washington, D.C.: Government Printing Office, 1977, p. 10; and U.S., Department of Commerce. Federal and State Indian Reservations and Indian Trust Areas. Washington, D.C.: Government Printing Office, 1974.

these three states. Over 85 percent of the nation's proven uranium reserves are located in these three states.[1]

2.2.2 Population

Compared to much of the rest of the nation, the eight states in our study area are small in population. Colorado is largest with about 2.5 million, followed by Arizona with about 2.2 million. The remaining six states have from 1.2 million (Utah) to .4 million (Wyoming) and rank among the 15 least populated states in the country. All of the eight states are substantially under the 4.3 million average population of the 50 states.[1]

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[1] Bendix Field Engineering Corp. Survey of Lands held for Uranium Exploration, Development and Production in Fourteen Western States in the Six Month Period Ending December, 1976, GJBX-33(77). Grand Junction, Colo.: U.S., Energy Research and Development Administration, 1977, p. 1; and U.S., Energy Research and Development Administration, Grand Junction Office. Statistical Data of the Uranium Industry, GJO-100(77). Grand Junction, Colo.: U.S., Energy Research and Development Administration, 1977, p. 61.

Except for the five large metropolitan areas identified earlier, the states are relatively sparsely populated. Only three of the eight states have population densities of greater than 10 per square mile; Wyoming, with fewer than 4 per square mile, is the least densely populated state in the study area. In contrast, the national average is approximately 60 persons per square mile. Only in North and South Dakota do more than 50 percent of the people live in rural areas, about 55 percent in both cases. The other six states range from about 55 to 80 percent urban, the most urban being Utah, Arizona, and Colorado, each of which is about 80 percent urban. As the data on population density indicates, this high percentage is a consequence of the concentration of state's population in large metropolitan areas.

2.2.3 The Economy

Agriculture, mining, government, and services are the major sectors of economic activity in the eight-state study area. Manufacturing is a major employer in only three of the eight states: Arizona, Colorado, and Utah. Overall, states in the area are less manufacturing oriented than are states in any other region of the nation.

Census data for 1970 indicate that median family income in all eight of the states is below the national average of approximately $9,600 per year. Arizona, Colorado, and Utah, the three most populous states, come closest to the national average: Colorado (-$35); Arizona (-$403); and Utah (-$207).[2]

Industrial development in the area is concentrated in several large metropolitan areas: Albuquerque, Denver, Phoenix, Salt Lake City, and Tucson. Heavy manufacturing is confined exclusively to the vicinity of those cities while some light manufacturing is found in smaller urban areas (such as Casper, Grand Junction, and Billings). Outside these areas, industrial development is generally limited to mining and wholesale and retail trade. The metropolitan and smaller urban areas are where most of the financial and government employers are located.[3]

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[1] U.S., Department of Commerce, Bureau of the Census. Pocket Data Book, USA 1976. Washington, D.C.: Government Printing Office, 1976, p. 46. All data are for 1975.

[2] Median family income in Arizona would be above the national average if the Navajo reservation were excluded. This emphasizes how low income is on the reservation.

[3] Denver ranks second among U.S. cities in terms of federal employment.

2.2.4 Public Values and Attitudes

Outside the five major metropolitan areas, the lifestyle reflects the slower, more relaxed pace generally associated with small towns and rural areas. A sense of the frontier is still evident, and rugged individualism remains a highly regarded value.

The area is not identified with any particular religion although Catholicism is more prevalent than in the nation as a whole. Mormonism is pervasive in several of the Rocky Mountain states. An obviously strong feeling in the area is that "you take care of your own" rather than depend on government. If this feeling is not attributable to Mormonism, it appears to be strongly reinforced by it.

Whatever its source, there is a strong strain of populism in the eight-state area. One manifestation of this is an obviously strong opposition to most kinds of government intervention, including environmental controls which affect resource development. There is also a very distinct antipathy toward planning, particularly any attempt to put limits on the uses to which owners can put their real property.

2.2.5 Western Attitudes Toward Energy Resource Development

It is difficult to generalize about attitudes toward energy resource development within the eight-state study area. Environmental quality, scenic beauty, and present lifestyle are obviously widely held values. But so are higher personal incomes, more job opportunities, more amenities, easier access to medical services, and a variety of other benefits associated with energy resource development. Both kinds of values can be and apparently often are held by the same person. Since these values are often in conflict, it is difficult for westerners both individually and collectively to be consistent in expressing their attitudes toward energy development.

However, there do seem to be several consistent themes among westerners. For example, outside the large metropolitan areas there is a general opposition to the intervention of outsiders whether the intervenor be the federal government or the Sierra Club. Westerners generally seem to believe that they should be the ones to decide their futures; for example, public officials in southern Utah believe they should decide whether maintaining 75-mile visibility is more or less highly valued than the anticipated economic and fiscal benefits of energy resource development.[1]

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[1] This is the position strongly expressed to members of the Science and Public Policy Research Team who visited the area.

Public opinion concerning energy resource development in the eight-state study area has not been scientifically polled. However, Colorado, Wyoming, and Utah were included in a recent opinion poll conducted by U.S. News & Work Report in a number of western states. A higher percentage of the residents in these three states believe that the energy problem is serious than do residents of the nation generally--47 percent as compared to 30 percent.[1] More than half (52.5 percent) of those polled in the three states responded negatively to the statement that "Having completely clean air and water is worth paying whatever higher prices and higher taxes are needed"--in contrast to a 41 percent negative response to the same question nationwide.[2] And when asked whether "government should permit increased strip mining because of the country's need for coal," 62.1 percent of those polled in the three states responded affirmatively as compared to 56.9 percent affirmative response nationwide.[3]

On the basis of our contact with public officials in local and state government, our overall impression is that much of the West is more prodevelopment than is generally realized. Although the strength of these feelings varies considerably among the eight states, Utah and Wyoming seem to us to manifest the strongest prodevelopment position and Montana the weakest.[4] But in several of the states, it is not so much an antidevelopment attitude that is being manifested as a demand that the West not be treated as a national sacrifice area.

Westerners often ask "Why should we develop our energy resources for the benefit of other regions of the country?" For example, Governor Apodoca of New Mexico has stated explicitly that "We're not interested in being a colony for the rest of the country."[5]

Colorado's Senator Hart has introduced legislation in the U.S. Senate calling for federal impact assistance to compensate the West and to help state and local governments mitigate the undesirable consequences of energy resource development.[1] And several states have enacted severance taxes which are intended to insure that consumers who enjoy the energy benefit of western energy development compensate the West for the development costs the region experiences.[2]

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[1] Reported in the Denver Post, May 14, 1978, p. 3E.

[2] Ibid.

[3] Ibid.

[4] See Christiansen, Bill and T.H. Clack, Jr. "A Western Perspective on Energy: A Plea for Rational Energy Planning." Science, Vol. 194 (November 5, 1976), pp. 578-84.

[5] Congressional Quarterly, Inc. Congress and the Nation, Vol. IV: 1973-1976. Washington, D.C.: Congressional Quarterly, 1977, p. 205.

2.2.6 Summary

The overall picture which emerges from this description of energy resource development is that the eight-state study area is large in land area, sparsely populated, energy-rich, water-poor, relatively unindustrialized, largely subject to the control of the energy resource and land-use policies of an absentee federal landlord, and strongly opposed to federal intervention, particularly when it affects westerners' right to do what they want to do with their personal property and lives.

2.2.7 Organization of This Chapter

The remainder of this chapter is divided into three major sections. The first of these describes the energy technologies and development alternatives being considered in this study. In the second major section, national and state policies which can significantly affect western energy resource development are identified and discussed. This discussion links western energy development to the discussion of national policies in Chapter 1 and to the specifically regional factors and considerations which affect western energy resource development, including some of those identified above. A final section summarizes some of the major aspects of public-private and intergovernmental relationships which help shape the regional context of western energy resource development.

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[1] Senate Bill 1493, Inland Energy Development Impact Assistance Act of 1977.

[2] See Section 2.4.2. Montana's severance tax on coal is the highest in the area. Wisconsin Power and Light Co. is challenging this tax on the basis that it is excessive and a burden on commerce. See "The Fuels Outlook." Electrical World, Vol. 189 (March 1, 1978), p. 49.

2.3 ENERGY TECHNOLOGIES AND DEVELOPMENT ALTERNATIVES[1]

When the western energy resources described above are developed, the effects on the West and the rest of the nation will vary depending upon the level, rate, pattern, and technological alternatives chosen. In general, the higher the level of regional development the greater the contribution of the West to national energy supplies and the greater the costs, risks, and benefits for the West.

With regard to patterns of development and technological alternatives, coal offers the greatest range of options. Coal can either be burned directly or converted to electricity, synthetic gas, or a synthetic liquid. The coal conversion technologies examined in this study are: steam electric power generation, Lurgi and Synthane high-Btu (British thermal unit) gasification, and Synthoil liquefaction (see Table 2-3). All of these are sited at or near the mine-mouth. Both surface and underground mining are considered. Both unit train and slurry pipeline transportation are examined for exporting coal to load center conversion sites.

In contrast to coal, geothermal, oil shale, and uranium cannot be exported as raw resources. The geothermal development alternative considered is on-site steam-electric power generation (see Table 2-4). Both surface and solutional mining alternatives are examined for uranium with both kinds of mines supplying uranium ore to a uranium mill for processing into yellowcake (see Table 2-5).

Two oil shale conversion options are considered: underground mining with TOSCO II surface retorting; and modified *in situ* (see Table 2-6). Shale oil can either be upgraded on-site or transported to a refinery for processing. Both conventional extraction and production enhanced recovery technologies are examined for oil. Conventional extraction and production of natural gas are also considered (see Table 2-7). Both synthetic oil and gas are transported by pipeline, and electricity is transmitted by extra-high voltage transmission lines.

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[1] The energy technologies considered in this study are described in White, Irvin L., *et al*. *Energy From the West: Energy Resource Development Systems Report*. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming. The preliminary results of our analysis of the impacts of deploying these technologies in the West are reported in White, Irvin L., *et al*. *Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development*. Washington, D.C.: U.S., Environmental Protection Agency, 1977. Final results will be reported in White, Irvin L., *et al*. *Energy From the West: Impact Analysis Report*. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

TABLE 2-3: COAL RESOURCE DEVELOPMENT ALTERNATIVES[a]

ALTERNATIVE EXAMINED	BRIEF DESCRIPTION
Mining	
Surface	Coal is strip-mined by using a scraper and dragline or shovel to remove over-burden to expose the coal seam, shovels or excavators to mine the coal, and conveyors or trucks to transport the coal to a facility where it is prepared for shipping or on-site use. Surface-mined lands are usually reclaimed as an integral part of mining. The mined area is reshaped to approximately its original contour by bulldozers or scrapers, fertilized, seeded, and, if necessary, irrigated.
Underground	The coal deposit to be mined is reached by digging or boring a tunnel. In the U.S., the coal is usually mined using a technique called room and pillar; this involves mining the coal to create rooms while leaving pillars of coal in place to prevent the overlying strata from collapsing into the mine.
Direct Export	Raw coal can be exported by unit trains which are usually made up of 100 gondola cars each of which carry 100 tons of coal. Raw coal can also be exported by slurry pipeline. When this method is used, the coal is pulverized, mixed with water, and pumped through a pipeline.
Conversion to Electricity	The chemical energy in coal is converted to heat energy in a conventional boiler to produce steam; the heat energy in the steam is converted to mechanical energy by a turbine and then converted to electricity by a generator.
Cooling	Waste heat can be dissipated by either: (1) once-through cooling (water for cooling is drawn from a lake or stream, used once for cooling and returned to the lake or stream); (2) wet cooling towers (heat is dissipated by evaporation); (3) dry cooling towers (water is circulated in a closed system and cooling occurs much as with a radiator in a car); or (4) some combination of wet-dry cooling towers.
Environmental Controls	Stack gas scrubbers remove sulfur dioxide by passing the flue gas over or through a material (generally lime) which reacts with the sulfur dioxide to form a compound which can either be disposed of as a solid waste or treated to recover sulfur that can be used in some way. Particles (or particulates) are removed either: (1) mechanically (by rotating the flue gases very rapidly in a cyclone); (2) electrostatically (by passing the flue gases over a very high electric field on a series of wires and tubes or wires and plates, ionizing the particles, and drawing them to the tubes or plates); or (3) to some limited extent, as a part of sulfur dioxide removal.

TABLE 2-3: (Continued)

ALTERNATIVE EXAMINED	BRIEF DESCRIPTION
Conversion to Synthetic High-British thermal unit (Btu) gas	Coal can be converted into synthetic high-Btu gas by chemically synthesizing carbon, hydrogen, and oxygen. Lurgi is a first-generation coal gasifier in which pulverized coal, steam, and oxygen are introduced into a pressurized reactor vessel and reacted at a temperature of 800 to 1,000°F to produce a synthetic gas. This gas is then cleaned and upgraded by reacting carbon with hydrogen to produce gas of pipeline quality. Synthane is a coal gasification technology still in the development stage. In this process, coal, steam, and oxygen are introduced into a heated, pressurized pretreatment vessel. The coal and gases from the preheater are then introduced into a 1,000°F gasifier along with additional steam and oxygen. Gas from the gasifier is then cleaned and upgraded to produce high-Btu pipeline quality gas.
Conversion to a Synthetic Liquid	Synthoil is a coal liquefaction technology still being developed. In this process, crushed coal is slurried in oil, heated, and, together with hydrogen, introduced into a pressurized reactor and heated to 850°F. Hydrogen is transferred to the coal, yielding oil, gases, and solids. The oil is separated for use as a fuel oil or for refining into other petroleum products.
Transportation of Fuels	Electricity produced from coal is transported at high voltages by over-head transmission lines, underground cables, or some combination of the two. Synthetic gases and liquids are transported by conventional pipelines.

[a] Based on University of Oklahoma, Science and Public Policy Program. *Energy Alternatives: A Comparative Analysis.* Washington, D.C.: Government Printing Office, 1975; and White, Irvin L., *et al.* *Energy From the West: Energy Resource Development Systems Report.* Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

TABLE 2-4: GEOTHERMAL RESOURCE DEVELOPMENT ALTERNATIVES[a]

ALTERNATIVE EXAMINED	BRIEF DESCRIPTION
Drilling	Geothermal drilling is similar to drilling for oil or gas except that penetration rates are generally slower (due to harder rock), temperatures are higher, and cooling towers may be required to cool drilling mud.
Production of Hot Water and Hot Rock Reserviors	In hot water reservoirs, pressure differentials force steam or hot water to the surface. The surface installation includes valves to control pressure and separators to remove liquids and solids. When hot rock resources are being produced, water is introduced from the surface and heated or converted to steam when it contacts the hot rock at the bottom of the hole. The hot water or steam is then returned to the surface.
Conversion to Electricity	The heat energy from geothermal resources is used to produce electricity by driving a steam turbine and a generator.

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[a] Based on University of Oklahoma, Science and Public Policy Program. Energy Alternatives: A Comparative Analysis. Washington, D.C.: Government Printing Office, 1975; and White, Irvin L., et al. Energy From the West: Energy Resource Development Systems Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

TABLE 2-5: URANIUM DEVELOPMENT ALTERNATIVES[a]

ALTERNATIVE EXAMINED	BRIEF DESCRIPTION
Mining	
Surface	Uranium is usually mined in open pits much like copper. Mined ore is moved from the mine by trucks.
Underground	Underground uranium mines follow the vein of ore being mined and use timbers and roof bolts to support the shaft. The technique is much more like that used in mining hard minerals than in mining coal. Uranium mines also have special ventilation requirements because of the radon gas emissions from the uranium. Large capacity air circulation pumps are used in conjunction with special exhaust fans.
Solutional	Solutional mining of uranium involves the in situ leaching of uranium ore from underground mineral deposits. Wells are drilled and an acid leaching solution pumped into the ore body. The solution containing the dissolved uranium is then drawn off through production wells.
Milling	Milling is the process used to convert uranium ore into a compound called "yellowcake." Yellowcake contains 80 to 82 percent U_3O_8 (uranium oxide) as compared to about 0.2 percent U_3O_8 in the mined ore. The ore is crushed and ground, leached (the uranium minerals dissolved from the host rock), washed, purified (to leave impurities in the wash water), precipitated (to make the uranium insoluble), separated, and packed in drums for shipping.
Transportation	Most yellowcake is transported by truck.

[a] Based on University of Oklahoma, Science and Public Policy Program. Energy Alternatives: A Comparative Analysis. Washington, D.C.: Government Printing Office, 1975; and White, Irvin L., et al. Energy From the West: Energy Resource Development Systems Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

TABLE 2-6: OIL SHALE RESOURCE DEVELOPMENT ALTERNATIVES[a]

ALTERNATIVE EXAMINED	BRIEF DESCRIPTION
Underground Mining	Oil shale is mined underground using a room and pillar technique similar to that used in underground coal mining. However, the floor to ceiling clearances in the mine are much greater, ranging from about 60 to 80 feet. Mining takes place at two levels of 30 to 40 feet. The oil shale is fractured by blasting and then loaded by a large front-end loader onto trucks similar to those used in surface coal mines. These trucks transport the oil shale to the surface retort.
Surface Retort	The TOSCO II surface retort produces shale oil introducing crushed oil shale into a horizontal retorting kiln heated to about 580 to 950°F. The shale is heated by hot combustion gases in a preheater and then moved into the reactor where it is mixed with small marble-like ceramic balls. The heat transferred to the shale from the balls effects pyrolysis, and the shale gives off a mist of oil, steam and gases. The oil is separated to be further processed on-site or shipped to a refinery for processing. The large quantities of spent shale are disposed of by filling canyons or by returning it to the mine.
Modified In Situ	The modified in situ process involves sinking a shaft and tunneling into the lower levels of the oil shale zone to be developed in situ. A room approximately 200 feet square and 300 feet high is mined out and an oil collection system installed. The shale is then collapsed into the mined-out room by blasting. Holes are drilled from the surface into the top of the room. The collapsed shale is burned, the combustion being assisted by air blown in from the surface. The shale oil is collected at the bottom of the room and pumped to the surface for on-site processing or shipping to a refinery for processing. The mined-out shale may be retorted in a surface retort or disposed of as a solid waste.
Transportation	The shale oil or, if processed on-site, the refined products are shipped by pipeline or tanker.

[a] Based on University of Oklahoma, Science and Public Policy Program. Energy Alternatives: A Comparative Analysis. Washington, D.C.: Government Printing Office, 1975; and White, Irvin L., et al. Energy From the West: Energy Resource Development Systems Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

TABLE 2-7: OIL AND NATURAL GAS DEVELOPMENT ALTERNATIVES[a]

ALTERNATIVE EXAMINED	BRIEF DESCRIPTION
Conventional Drilling	Both exploratory and production wells are drilled using a rotary drill (2 drill bits on the end of a length of pipe called a drill string are rotated at the bottom of the hole being drilled). A fluid called drilling mud is used to remove cuttings and maintain pressure in the hole. Steel casing is cemented as a liner in the hole to help prevent blowouts.
Conventional Production	Wells are produced by installing a "Christmas Tree" or control valves, and when necessary, an artificial lift such as pumps is used to produce oil.
Enhanced Oil Recovery	To enhance recovery of oil in wells in which flow has diminished. The reservoir may be water, steam, or polymere flooded or a variety of fluids can be used to improve flow characteristics.
Transportation	Both oil and gas are transported by pipeline, oil to refineries and gas to end users.

[a] Based on University of Oklahoma, Science and Public Policy Program. Energy Alternatives: A Comparative Analysis. Washington, D.C.: Government Printing Office, 1975; and White, Irvin L., et al. Energy From the West: Energy Resource Development Systems Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

TABLE 2-8: LOW AND NOMINAL DEMAND CASE SCENARIOS OF WESTERN ENERGY RESOURCE PRODUCTION

ENERGY TYPE	Q'S FROM EIGHT STATE REGION[a]						
		NOMINAL DEMAND CASE			LOW DEMAND CASE		
	1975	1980	1990	2000	1980	1990	2000
Coal Production[b]	1.57	5.04	12.60	29.90	4.28	9.80	22.10
Direct Use	1.50	3.73	8.30	14.80	3.13	6.38	11.10
Unit Train	1.50	3.14	5.33	7.07	2.71	4.13	5.28
Slurry Pipeline	0	0.52	2.97	7.75	0.42	2.26	5.79
Gasification	0	0	0.23	3.83	0	0.15	2.30
Liquefaction	0	0	0.001	0.31	0	0.001	0.38
Electrical Generation	0.03	0.48	1.08	1.43	0.41	0.84	1.08
Oil Shale	0	0.001	0.95	4.76	0.001	0.19	0.95
Uranium Fuel	1.95	4.77	12.70	23.80	4.15	9.46	17.10
Gas (Methane)	1.71	1.97	2.08	1.06	1.99	1.89	1.19
Domestic Crude Oil	1.43	1.67	1.32	1.03	1.74	1.34	1.20
Geothermal	0	0	0.09	0.15	0	0.01	0.02
Total	6.66	13.45	29.74	60.70	12.16	22.69	42.56

Q = 10^{15} British thermal units. One Q equals approximately 175 million barrels of oil, 60 million tons of western coal, or one trillion cubic feet of natural gas.

[a] Input values for coal direct use; output values for others.

[b] Coal subcategories do not add to total because of energy losses in the energy conversion subcategories.

Two energy resource development scenarios, Nominal and Low Demand cases, were developed to serve as a basis for identifying impacts and issues resulting from energy development in the eight western states. The Stanford Research Institute's interfuel competition model was used to construct these two scenarios, which are further described in Chapter 11 of our Impact Analysis Report.[1] The Nominal and Low Demand case scenarios contain a national energy supply of 155.1 quads (Q) and 124.0 Q respectively for the year 2000. The contribution from the eight state study area in the year 2000 is 60.70 Q and 42.56 Q for the Nominal and Low Demand cases, respectively. The amount of energy by resource type produced by the eight western states for these two scenarios is shown in Table 2-8.

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[1] White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming, Chapter 11.

The consequences for the West can be quite different depending upon whether an export or mine-mouth alternative is chosen. For example, converting coal to electricity or a synthetic gas or liquid within the eight-state area will almost always increase the costs, risks, and benefits for the area. On the other hand, exporting raw coal will usually decrease them. Just how much conversion within the area will increase and export decrease costs, risks, and benefits will depend upon national, state, and local laws, regulations, and policies. For example, a major economic benefit produced by converting coal within the eight-state area will be a large increase in the property tax base. A state might elect to use a severance tax to obtain the same increase in revenues from exported coal; however, if the conversion facility is not located within the area, employment opportunities will be fewer, population growth lower, and overall economic growth less.

Air and water quality impacts will also generally be less in the eight-state area if raw coal is exported rather than converted on-site. While there will still be air and water quality impacts from mining and transporting the coal, these will be much less than would be experienced if the coal were converted on-site to electricity or to a synthetic gas or liquid. Again, regulations and policies can be designed to lessen the adverse impacts of on-site conversion. For example, highly efficient environmental control technologies can be required and strict siting requirements imposed.

Water availability problems can be decreased in water-scarce areas if coal is exported by train. But again, these problems can be lessened by requiring the use of water minimizing technologies such as wet/dry rather than wet cooling and process design changes which would decrease water consumption.

Exporting coal can also export some of the costs and benefits to the demand center where the coal is burned or converted. For example, exporting the coal from the West will generally increase air quality problems in the demand center, many of which already have air quality problems. While the increased ambient concentrations of air pollutants in the West might decrease visibility and produce episodic violations of ambient air quality standards, the same incremental increase in the vicinity of the demand center might have serious economic and human health effects.

As noted above, the on-site effects of developing geothermal, oil shale, oil, natural gas, and uranium generally cannot be exported.[1] However, effects can vary depending upon which development alternative is chosen. These differences are reported in Energy From the West: A Progress Report of a Technology

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[1] As noted above, shale oil can either be upgraded on-site or shipped to a refinery. Exporting the shale oil for processing decreases on-site effects.

Assessment of Western Energy Resource Development[1] and are summarized where appropriate in the analysis of categories of problems and issues in Part II below.

National and state policies will determine which of the range of possible levels, rates, patterns, and technological alternatives will actually be chosen in developing western energy resources. Policies most likely to have a significant effect on these choices are discussed in the following section.

2.4 NATIONAL AND STATE POLICIES AND WESTERN ENERGY RESOURCE DEVELOPMENT

2.4.1 Introduction

As stated in the context of energy policy, our overall national, energy, economic, and environmental objectives are to provide sufficient energy from secure sources to support continued economic growth and to minimize changes in lifestyles while continuing to maintain and enhance environmental quality. The obvious interdependencies and interrelationships among these three areas of public policy at the national level were discussed briefly in Chapter 1. In this section, both national and state energy, economic, and environment policies as they affect western energy development will be discussed. The effects of other related policies such as siting, land use, and water policies will also be discussed briefly.

2.4.2 Energy, Environmental, and Economic Policies

A. Introduction

The elements of national energy policy which will affect western energy resource development most directly through the year 2000 are those which emphasize domestic energy development, promote the production and utilization of certain energy resources (particularly coal, uranium, and oil shale), and support the development and encourage the deployment of certain technologies (such as coal gasification and liquefaction). Otherwise it is likely to be either the economic or environmental elements of national energy policies that will most significantly affect how much and where western energy resources will be developed and which technologies will be used to develop them. It is also likely that it will be the western states' environmental, economic, and other policies such as siting and water policies that will play the major role in shaping energy resource development in the study area.

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[1] White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977.

B. Energy Policy

Since the 1973 Organization of Petroleum Exporting Countries embargo, a consistent theme in national energy policy has been to achieve independence from insecure foreign sources of energy. Until the President's National Energy Plan[1] (NEP) was proposed and the Clean Air Act Amendments of 1977[2] enacted, this policy had the effect of promoting western energy production, particularly coal. But the NEP proposes and the amendments require all new coal-burning facilities to be equipped with the "best available control technology" (BACT) to reduce the emission of air pollutants. Since the principal advantage western coal has had over coal from other regions is its low sulfur content, the BACT requirement can be, at least in the short term, a significant factor in determining how much western coal is produced.[3]

The NEP assumes that, in the short term, most coal will be burned directly (including coal-fired steam-electric power generation). In fact, the NEP, which promotes coal production and utilization, includes several provisions which encourage the direct burning of coal, including policies which would raise oil and natural gas prices, fuel switching requirements which would switch industrial and utility users from oil and natural gas to other fuels, primarily coal, a prohibition against the use of oil and natural gas in new industrial and utility boilers, and taxes on the use of oil and natural gas.

Although the NEP does call for government support of commercial-size demonstrations of both solvent refined coal and low-Btu gasification technologies and an active high-Btu gasification research and development program, it does not propose either to subsidize coal gasification or liquefaction or to insure private developers against the large financial risks currently associated with these technologies. This policy does not encourage and, in fact, probably has the effect of discouraging the development and deployment of coal gasification and liquefaction technologies.

Oil shale is not emphasized by the NEP either. While noting that oil shale is the potential source of billions of barrels of oil, the NEP states that environmental and economic problems will have to be overcome for this potential to be realized. The contribution of the NEP toward resolving these problems is to entitle shale oil to the world price of oil. This policy has already been put into effect and could speed up the development of this resource.

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[1] U.S., Executive Office of the President, Energy Policy and Planning. The National Energy Plan. Washington, D.C.: Government Printing Office, 1977.

[2] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 685.

[3] This topic will be discussed in more detail in the following section.

The NEP deemphasizes advanced nuclear technologies, largely because of safeguards problems, but it does call for more light-water reactors, and, therefore, increased uranium production. As for the other resources considered in this study, geothermal is to receive the same tax deduction for intangible drilling costs that oil and natural gas now receive, streamlined leasing procedures are to be developed, and additional research and development funding is proposed. With regard to oil and natural gas, the NEP calls for pricing policy to provide new incentives. The intended effect is to increase the identification and production of oil and natural gas resources, including those located in the western U.S., and to promote production from stripper wells and enhanced recovery in old fields.

C. Environmental Policies

As noted earlier, both national and state environmental policies can have a significant effect on western energy resource development. For example, energy development in the West will have to meet either national ambient air quality standards (NAAQS) or more stringent state standards (of the eight states studied only Utah does not have more restrictive standards), new source performance standards (NSPS), prevention of significant deterioration (PSD) increments, and the BACT requirements mentioned above. Energy development in the region will be especially affected by PSD regulations which are intended to protect air quality in areas where air quality is currently better than the quality provided by NAAQS. This is because there are many areas in the West which either already are or are potentially Class I PSD areas (such as national parks, forests, wilderness, and recreation areas). One likely effect of PSD requirements will be to limit the size and probably the number of energy conversion facilities (such as coal-fired steam-electric power and synfuels plants) that can be sited in the West.[1]

As mentioned above, the BACT requirement decreases the advantage low sulfur western coal has over coal from other regions. A recently published report on the effects of the BACT requirement indicates that western coal production will be substantially lower than it would have been in the absence of this requirement.[2] This study found that the reduction could be about 23 percent by 1985 and about 42 percent by 1990.[2] The National Environmental Policy Act of 1969[3] (NEPA) has also had and can be expected to continue to have a significant impact on western energy resource development, both on a site-specific and region-wide basis; among the provisions intended to achieve the overall objectives of the Act is a requirement that an environmental impact statement (EIS) be prepared by federal agencies for any proposed action which would significantly affect the quality of the human environment.[4] An agency's draft EIS is widely reviewed both within government and externally before a final EIS is approved. And the adequacy of the final EIS subsequently approved may be challenged. For example, the Department of the Interior's Final Coal Programmatic EIS was challenged by the Natural Resources Defense Council (NRDC) on the grounds that the statement failed to demonstrate the need for more federal coal leasing and that the description of the proposed leasing systems in the EIS was inadequate.[5] The U.S. Court of Appeals for the District of Columbia sustained NRDC's challenge and enjoined the Department of the Interior (DOI) "from taking any steps, whatsoever, directly or indirectly, to implement the new coal leasing program."[6] This injunction has the effect of continuing a moratorium on coal leasing which was officially in effect while the Department of Energy (DOE) reviewed

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[1] For more details, see Chapter 6 below on Air Quality Problems and Issues.

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[1] Krohm, G.C., C.D. Dux, and J.C. Van Kuiken. Effect on Regional Coal Markets of the "Best Available Control Technology" Policy for Sulfur Emission, National Coal Utilization Assessment. Argonne, Ill.: Argonne National Laboratory, 1977. Reduced production would be due primarily to transportation costs. That is, if BACT has to be installed regardless of what coal is used, transporting either coal or electricity from the West would be more expensive than using local coal.

[2] Ibid., p. 47. The decrease would occur mainly in the Northern Great Plains. Production in the rest of the West would increase slightly less than 2 percent by 1985 and 15 percent by 1990, primarily by replacing Northern Great Plains coal in southwestern markets.

[3] National Environmental Policy Act of 1969, Pub. L. 91-190, 83 Stat. 852, 42 U.S.C. § 4321-47 (1970).

[4] Ibid., Section 102(2) (C).

[5] Quoted by Turcott, George L. (Associate Director, Bureau of Land Management, Department of the Interior). "The Full Scope of the Hydrocarbon Leasing Program." Paper presented at the annual meeting of the American Association for the Advancement of Science, Washington, D.C., February 16, 1978.

[6] Ibid.

its procedures and issued the final coal programmatic EIS. Although the official moratorium was not announced by Secretary of the Interior Morton until February 1973, coal leasing has actually been stalled since May 1971.[1] A major effect has been to reduce speculative activity about coal development in the West since the federal government controls such a large percentage of the coal located there.

Secretary of the Interior Kleppe terminated the moratorium in January 1976, but no coal leases were made prior to the current injunction being granted. Secretary Andrus recently announced an agreement which would allow Interior to resume limited leasing of coal deposits on federal lands in the West to allow operators to fulfill existing contracts. However, the plan still must be accepted by the district court which issued the injunction.

Five of the eight states in our study area have also either enacted environmental protection acts or established an administrative equivalent. To date none of these acts of administrative programs has had the effect on western energy resource development that NEPA has had. On the other hand, they have not been in effect as long.

Other national environmental or environmentally-related policies and regulations which will affect western energy development include those which are intended to protect water quality,[2] maintain the natural character of wild and scenic streams,[3] protect and preserve endangered species,[4] control the disposal of toxic substances,[1] protect drinking water supplies,[2] restore surface-mined lands,[3] and develop comprehensive land-use plans.[4]

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[1] See Magida, Arthur J. "Environmental Report/Major Revisions Likely in Federal Coal Leasing Program." National Journal, Vol. 7 (August 2, 1976), pp. 1101-9; and "U.S. Coal Leasing of West's Coal Lands to Resume." Denver Post, February 26, 1978.

[2] Federal Water Pollution Control Act as amended by Clean Water Act of 1977, Pub. L. 95-217, 91 Stat. 1566.

[3] Wild and Scenic Rivers Act of 1968, Pub. L. 90-542, 82 Stat. 906.

[4] Endangered Species Preservation Act of 1973, Pub. L. 93-205, 87 Stat. 884.

D. Economic Policies

The economic effects of several of the energy and environmental policies discussed above can also affect western energy resource development. For example, the previously cited Argonne study of the effects of the BACT requirement, found that the BACT requirement will increase the "within the fence" economic cost of using coal in areas where low sulfur western coal is now being used to meet NSPS by 20 to 25 percent. In contrast, the increased cost in areas where high sulfur eastern coal is now being used to meet NSPS will be 8 to 10 percent.[5] An additional effect is to "...make coal-generated electrical power more expensive relative to nuclear power. This should widen the cost advantage that nuclear plants appear to enjoy in many areas."[6] Consequently, the BACT requirement could have the added effect of increasing uranium production in the eight-state study area.

As noted earlier, the NEP does not propose either to subsidize synfuels or to insure private developers against the large financial risk currently associated with their production. The exception is entitling shale oil to world prices, otherwise, without a subsidy, synfuels are not currently competitive. And, as noted earlier, one economic effect of the NEP's synfuels provisions will likely be to downplay the development and deployment of coal gasification and liquefaction and oil shale retorting technologies.

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[1] Toxic Substances Control Act of 1976, Pub. L. 94-469, 90 Stat. 2003.

[2] Safe Drinking Water Act of 1974, Pub. L. 93-523, 88 Stat. 1660.

[3] Surface Mining Control and Reclamation Act of 1977, Pub. L. 95-87, 91 Stat. 445.

[4] Federal Land Policy and Management Act of 1976, Pub. L. 94-579, 90 Stat. 2743.

[5] Krohm, G.C., C.D. Dux, and J.C. Van Kuiken. Effects on Regional Coal Markets of the "Best Available Control Technology" Policy for Sulfur Emission, National Coal Utilization Assessment. Argonne, Ill.: Argonne National Laboratory, 1977. The percentage increase would probably be less if overall costs such as transportation were included.

[6] Ibid.

Environmental laws and requirements can also increase the economic cost of energy resource development by providing opponents of particular projects (such as constructing a single coal-fired steam-electric power plant) or of major regional programs (such as coal leasing) a means of delaying or stopping such projects and programs. For example, in April 1976, four Arizona, California, and Utah utilities abandoned plans to build a large coal-fired steam-electric power complex in the Kaiparowits Plateau in southern Utah. This project was opposed by environmental interests, represented primarily by the Audubon Society and the Sierra Club, primarily because of concern about the effect on air quality both within the immediate vicinity of the complex and on the eight national parks located within a 200 miles radius of the development site. When the decision was made to abandon the project, the four utilities had already invested four and one-half years and about $5 million. The point here is not to establish whether the utilities had proposed a "bad" siting choice for a large power complex; rather it is that objections based on environmental laws and regulations contributed to a decision to abandon the project. However, other factors contributed to the decision as well, including economic consideration and a decision by California to assume jurisdiction over California utilities' out-of-state facilities.

The complexity of existing siting processes also affected the utilities' decision and economic costs in the Kaiparowits case. Had they continued to try to win approval, the four utilities would still have had to obtain more than 200 permits from more than 40 federal, state, and local agencies prior to beginning construction.[1] As the discussion of siting problems and issues in Chapter 11 indicates, uncertainties associated with existing siting processes can add significantly to the economic costs of energy development.

As noted in the brief discussion of the NEP, tax policies affect the economics of energy development. For example, allowing intangible drilling costs to be written off by geothermal developers is intended to be a tax incentive. And, as mentioned earlier, the NEP proposes taxes which would increase the economic cost of using oil and natural gas.

At the state and local level, property and sales taxes can also affect the economic costs of energy. But severance taxes could have a larger effect on western energy development. The effective severance on tax rates of states in our study area are listed in Table 2-9.[1] While such taxes could have the effect of discouraging development in states that have high taxes, there is no evidence that this effect is occurring in the West. However, severance taxes do affect energy prices and, as will be described in Section 2.5, this can affect interstate relations when consuming states believe they are being "ripped off" by producing states.

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[1] Hall, Christian. "Huge Plant's Demise Signals Trouble Ahead for Energy Expansion." Wall Street Journal, September 7, 1976.

2.4.3 Other Policies

Policies outside the energy, economic, and environmental policy areas can also affect western energy development. The effects of one of these, facility siting, were briefly mentioned above. Five states in our study area have energy facility siting laws: Arizona, Montana, New Mexico, North Dakota, and Wyoming. While provisions vary, these laws generally have two or more of the following provisions or requirements: application fees, public participation, review of site selection, establishing need by forecasting demand, citizen suits, and environmental reports. These laws and siting problems and issues generally are discussed in detail in Chapters 7 and 12. The point to be made briefly here is that land-use policies generally and siting policies specifically can help to shape energy development.

Water availability ranks with air quality as one of the factors that can affect western energy development most significantly, particularly in the Upper Colorado River. As the description in Section 2.1 above noted, water is a scarce resource in much of the eight-state study area. Federal and state laws, interstate compacts, and international treaties can affect how much water is available and who gets it for what purposes. For example, each of the eight states has its own system for allocating water resources. The amount of water that the states can allocate is constrained not only by what is physically available, but also in the Colorado River Basin, by an interstate compact and a treaty with Mexico which together require either that 7.5 million acre-feet or 8.25 million acre-ft/yr be delivered to the Lower Basin.[2] The state allocation system is also threatened by the unquantified prior rights held by

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[1] From the point of view of municipal officials, severance taxes do not necessarily solve problems, primarily because the monies are not getting to the municipalities. This distribution problem is discussed in Chapter 10.

[2] Existing compacts call for 7.5 million acre-ft/yr to be delivered. The Mexican Treaty requires that 1.5 million acre-ft/yr be delivered to Mexico. As noted in Section 2.2.1.A, Upper Basin states maintain that they are not obligated to deliver any of this required water to the Lower Basin. If they are required to deliver half of this amount, the total they would have to deliver to the Lower Basin each year would be 8.25 million acre-feet.

TABLE 2-9: STATE MINERAL SERVANCE TAXES
(percent)

	COAL[a]	GAS AND OIL	URNAIUM
Colorado	7.2[b]	5.0[c]	2.5[c]
Montana	30.0	2.65	-[d]
New Mexico	4.6[b]	4.9[b,e]	5.0[b]
North Dakota	11.3[b]	5.0[c]	-[d]
Utah	0.0	2.0	1.0
Wyoming	10.5[f]	4.0	5.5

Source: Bronder, Leonard D. Severance Tax Comparisons Among WGREPO States, Staff Analysis No. 77-28. Denver, Colo.: Western Governors' Regional Energy Policy Office, June 1977.

[a] Surface-mined.

[b] Law written in cents per unit. Values of resources assumed here of: $8.33/ton for coal in Four Corners States, $5.73/ton for coal in Northern Great Plains, $1.45/thousand cubic feet for gas, $9.15/barrel for oil, $40/lb. for uranium (yellowcake).

[c] Before property tax credits.

[d] No taxable production in 1977.

[e] 3.4 percent effective rate for gas.

[f] Reverts to 8.5 percent after the 2 percent special levy has accumulated to $160 million (probably around 1993).

the federal government and Indian tribes. If the federal government quantified these, the whole state allocation system could be thrown into chaos.[1]

Water policies can also have economic effects. While high water prices are not likely to have much of an effect on energy prices, they can have a significant effect on other users, such as agricultural users. And if water users are required to use water minimizing technologies, economic costs will be high. For example, agricultural users could be required to use water-saving irrigation technologies such as a trickle system and energy developers could be required to use wet/dry rather than wet cooling as well as water minimizing process designs.[2]

Other policies can, of course, affect energy development. The detailed analyses of problems and issues in Part II will extend this brief introductory examination of how national and state policies can affect the development of energy resources in our eight-state study area.

2.5 RELATIONSHIPS WHICH HELP TO SHAPE THE REGIONAL CONTEXT OF WESTERN ENERGY RESOURCE DEVELOPMENT

2.5.1 Introduction

A range of public-private sector and intergovernmental relationships bring together the regional factors and national and state policies discussed above. In this section, some of the most important aspects of these relationships are discussed together with their possible effects on western energy resource development.

2.5.2 Public-Private Sector Relationships

Public-private sector relationships can affect energy resource development in a variety of ways. For example, siting decisions obviously involve government agencies, industry, and environmental interest groups. And landowners, local residents, chambers of commerce, labor unions, and others may also participate. Conflicts which arise among these participants as a consequence of a siting decision can have important political effects in the local community and surrounding area. For example, in Wyoming, energy development and subsequent conflicts over water rights have created alliances among traditional enemies. The Wyoming Stock Growers Association (WSGA) competes with the Union Pacific Railroad for water supplies. This competition has led WSGA to join forces with environmental interest groups and Union Pacific to become an ally of labor.[1] Based on their past relationships, both alliances are clear cases of common interests resulting in strange bedfellows.

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[1] Neither the Congress nor the Administration is likely to claim prior federal rights apart from the existing state allocation system. However, it is not clear that Indian rights will not be quantified. In fact, several cases are now before the courts.

[2] See Chapter 4.

Changing public-private sector relationships can also have consequences far beyond the immediate area around an energy development as the fifteen-year battle over the Kaiparowits project mentioned earlier illustrates. In part, that case represented a classic confrontation between industry and environmental interests. It illustrates both the level of complexity and uncertainty encountered in attempting to balance energy and environmental interests and values. As at the national level, increasing the number of participants and the range of interests that must be accommodated considerably increased the time required to make and implement workable policies and programs.

2.5.3 Intergovernmental Relationships in Western Energy Resource Development

A. Federal-State Relations

The response of western states to energy and environmental policy represents a change in federal-state relationships with respect to environmental standards. Environmental policy has been characterized historically by the federal government requiring states either to develop their own standards or to comply with federal regulations.[2] The intensity of the states' responses to this increases the likelihood of federal-state conflict. In fact, conflict has already emerged, for example, over the extent of state authority over reclamation on federal lands and whether energy development should occur on specific federal lands. Questions about state authority over reclamation on federal lands arose largely because there was no federal reclamation legislation before the Surface Mine Reclamation Act of 1977.[3] Because of the ambiguity of existing laws and regulations, most western states enforced their own laws on federal lands; in fact, all reclamation statutes enacted by the eight states either explicitly or implicitly stipulate that they apply to all mining activity within their boundaries, regardless of who owns the land.[1] Reclamation regulations proposed by DOI in January 1975 provided that federal reclamation provisions would prevail over state law on federal lands, and that DOI has the sole authority for designating federal lands suitable for mining.[2] In part, because of substantial opposition to these regulations by western states,[3] DOI changed the regulations to provide that states would be permitted as much control as constitutionally possible and that the states and DOI would enter into an agreement providing for joint administration and enforcement.[4]

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[1] Richards, Bill. "Changes Sweep into Wyoming." Washington Post, June 25, 1977.

[2] For an elaboration of this trend in air quality control, see Jones, Charles O. Clean Air: The Policies and Politics of Pollution Control. Pittsburgh, Pa.: University of Pittsburgh Press, 1975.

[3] Surface Mining Control and Reclamation Act of 1977, Pub. L. 95-87, 91 Stat. 445.

This failed to satisfy Wyoming which brought suit against DOI seeking recognition of Wyoming jurisdiction over mined land reclamation under its police powers.[5] DOI subsequently agreed that Wyoming's reclamation standards would take precedence over conflicting federal standards. DOI also indicated a willingness to negotiate settlements with other states whose reclamation laws were more stringent than federal regulations.[6]

However, two reclamation problems remain unresolved: first, the question of who should have control over the final decision as to whether energy development should occur on specific lands; and, second, the effects of the 1977 Surface Mining Act regulations[7] on federal-state agreements negotiated with DOI. The critical point about the 1977 Act is that it provides for a strong federal role in a policy area in which the trend had been toward increased federal-state cooperative agreements, granting states a larger and more active role in developing energy and environmental policy.

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[1] Barry, Hamlet J. Legal Study: Extent of State Control over Reclamation on Federal Land. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976.

[2] U.S., Department of the Interior, Geological Survey. "Coal Mining Operation Regulations." Federal Register, Vol. 40 (January 30, 1975), pp. 4428-38.

[3] See, for example, Federation of Rocky Mountain States, Inc. Proposed Federal Surface Mining Reclamation Requirements: A Report on the Workshop Held July 30, 1975. Denver, Colo.: Federation of Rocky Mountain States, 1976, p. 4.

[4] U.S., Department of the Interior, Bureau of Land Management and Geological Survey. "Coal Mining Operating Regulations." Federal Register, Vol. 41 (May 17, 1976), pp. 20,251-78.

[5] Herscheler v. Kleppe, Docket No. C-76-108 (D. Wyo., filed June 9, 1976).

[6] "Wyoming Coal Law Dispute Ends." Denver Post, December 4, 1976. Utah had also reached a similar agreement with Interior. See Strabala, Bill. "Utah Signs Coal Accord." Denver Post, January 7, 1977.

[7] See Federal Register, Vol. 42 (December 13, 1977), pp. 62,637-716.

This tension from reversal of trends in federal-state relations is perhaps even more evident in water policy. The states of the region have always had considerable responsibility in allocating water resources through state appropriation systems and interstate compacts and this responsibility had been increased in recent years by federal-state agreements. For example, Interior Secretary Andrus agreed to allow Montana to resell water from the Fort Peck Reservoir.[1] Further, states in the region have taken several recent initiatives in water policy, largely designed to increase state government control. These include Montana's moratorium on allocations from the Yellowstone River and Utah's development of the "Utah Plan"--a state water allocation system which substantially modified the appropriation system.

In this context of recent trends, federal-state tensions and additional demands for states' rights have increased during the past year because of federal proposals which have repeatedly threatened the western states. These threats began in the spring of 1977 with the Carter Administration's "hit list"--a proposal to limit or stop funding several water development projects because of questions about their economic and environmental cost benefits. Although these recommendations met with little success in Congress,[2] they were followed by a proposal to enforce a 1902 law which would limit the amount of land a farmer can irrigate with water from federal reclamation projects to 160 acres. Even more threatening to the western states has been the Administration's proposal for a new national water policy, which considered reforms in irrigation technologies, water pricing strategies, resource management and environmental protection strategies, and state water laws.[3]

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[1] Gill, Douglas. "Water May Be Auctioned Off." Denver Post, October 3, 1976.

[2] Of the 320 projects reviewed to see if they would receive federal funding, only eight western projects were cut back by Congress.

[3] For a review of these changes in federal policy, see Kirschten, J. Dicken. "Turning Back the Tides of Long-Time Federal Water Policy." National Journal, Vol. 9 (June 11, 1977), pp. 900-903.

Although the Carter Administration has relented on many aspects of these proposals,[1] they almost certainly have increased tensions over environmental policy and also have increased the tendency of western states to press for an active role in decisionmaking. For example, Wyoming Governor Herschler has said that these federal proposals would "upset the entire western agriculture" and called for equivalency standards which would allow ranchers in arid regions to irrigate more land than those in humid areas.[2] Western groups who have met with President Carter and Vice-President Mondale have strongly argued for state control over water management,[3] and Governor Lamm of Colorado has suggested that "most or all western governors are upset at the way the West has been treated in water policy."[4]

B. Interstate Relationships

Just as common interests among the states contribute to a sense of regionalism and give them a common cause in conflicts with the federal government, conflicting interests among the states can lead to conflicts among them. States often have different priorities, including the priority to be given to energy resource development. Utah, for example, seems to rank energy development higher and environmental protection lower than does its neighbor Colorado.[5] This raises the real possibility of conflicts between the two about air quality. If Utah is successful in reclassifying large areas within the state to Class III PSD areas, the resulting air quality effect will likely extend into

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[1] For example, in his recent tour of western states, Vice-President Mondale promised that the national water policy would not make recommendations interfering with state water rights. See Cannon, Lou. "Carter in Full Retreat on 'War on West.'" Washington Post, January 15, 1978.

[2] "Limits on Irrigation Opposed in Wyoming." Denver Post, November 16, 1977.

[3] Strain, Peggy, and Gary Cook. "Panelists Stress State Water Rights." Denver Post, December 19, 1977.

[4] Parsons, Dana. "West Fears Federal Power Grab." Denver Post, September 3, 1977.

[5] For example, Utah plans to revise some water projects, previously planned to promote agriculture, to develop energy resources. See Wynkoop, Steve. "Diversion of Water for Energy Studied." Denver Post, December 16, 1976. In contrast, Colorado will apparently use its newly acquired veto power to prevent agricultural water from the Savory-Pot Hook Project from being used for energy. See Larsen, Leonard. "Lamm Wins Right to Revise Energy Plans, Water Use." Denver Post, July 10, 1977.

Colorado, and affect Colorado's attempt to preserve its air quality by means of very strict air quality standards.

Interstate conflicts are also developing in the competition for scarce resources, particularly water. UCRB states seem to believe that Lower Basin states fail to take into account operational losses and uses of water in the Upper Basin, which leads the Lower Basin to have unreasonable expectations concerning how much water the Colorado can supply. And some of the states are busily allocating all of their share to prevent losing it in the future to downstream users. In fact, some of the states, such as New Mexico, have already allocated more than their share under the existing compact, if the low instream flow estimates are used.

C. Interregional Relations

Energy development also affects the relations of the West and individual western states with other regions. For example, their resentment of Montana's high severance taxes has led some nonwesterners to call Montanans "blue-eyed Arabs." In Michigan, where Detroit Edison Company has a 26-year contract for 193 million tons of Montana coal, one Detroit newspaper called the tax usurious and "fuel blackmail."[1] Last fall Montanans voted to put 25 percent of their coal tax revenues into a state trust fund with deposits increasing to 50 percent by 1980. States whose residents are paying higher energy prices because of Montana's severance tax don't believe Montana should be taxing to enlarge its general fund; they believe that the tax should only be at a level required to deal with impacts.[2]

Interregional disputes are also emerging over the broader question of where the major coal development will occur. In the Congress, debate over an amendment called the "local coal use mandate" has generated bitter regional rivalry, presented most vocally by Senators Clifford Hansen of Wyoming and Howard Metzenbaun of Ohio. As now formulated, the President would be able to require the use of local coals, in conjunction with appropriate emission control technologies if he determines that existing supply contracts will not be violated, that energy would not be wasted, and that significantly high costs to consumers would not result. President Carter supports this proposal and has announced his intention to reassess "the appropriate contribution of western coal to the national energy budget."[1] When this amendment was voted on in June 1977, the Senate dividing largely along regional lines, adopted it.[2] And it subsequently was incorporated into the 1977 Clean Air Act Amendments.[3]

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[1] Richards, Bill. "Boom in Strip Mining: Windfall for Montana." Washington Post, May 22, 1977.

[2] See "The Fuels Outlook." Electrical World, Vol. 189 (March 1, 1978), p. 49, concerning the previously mentioned challenge of Montana's tax by the Wisconsin Power and Light Co.

D. Intrastate Relationships

Energy development also creates conflicts among governmental units within states. However, conflicts usually arise more in connection with controlling large population increases than with balancing energy and environmental concerns. Such is the case for relations between state and local governments. Local governments in the West have traditionally paid little attention to the need for developing mechanisms to cope with energy problems, largely because energy has not been much of a local problem in the past. While local governments usually possess some instruments for controlling development, such as zoning ordinances, building codes, and health and sanitation standards, they also have serious limitations. One such limitation is that energy development usually occurs near small or rural towns which lack not only financial resources but also technical or planning expertise and adequate data bases.

In the West, local governments are often constrained by legal or constitutional restrictions imposed by the states. In some states, debt ceilings and limits on interest rates, and the existing tax structure limit local capacity to finance community facilities. The Utah constitution, for example, prohibits transfer of state revenues, including impact aid, to cities or counties.[4] Some states also restrict the freedom of local governments to require a developer to provide some kinds of public facilities, further limiting growth management alternatives.[1]

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[1] Kirschten, J. Dicken. "Watch Out! The Great Coal Rush Has Started." National Journal, Vol. 9 (October 29, 1977), pp. 1,683-85.

[2] Ibid.

[3] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 685.

[4] Although the state cannot transfer revenues, several mechanisms have been tried to get funds to local governments when they are needed. This has included prepayment of property and sales taxes (e.g., sales taxes on large components or equipment before they are needed) and establishing special service districts that can float bonds. Utah can build access roads and provide aid to impacted areas.

Another potential problem is fragmented authority over resource development. This authority is usually shared by cities, counties, councils of governments, special districts, and state agencies. Some of these governmental units further distribute administrative authority among their own administrative agencies. In such a fragmented system, the capacity of any one governmental unit to respond effectively to problems can be constrained to the point that no adequate response can be implemented.[2]

The combination of large, rapid population increases combined with existing constraints in intergovernmental relationships can create conflict among several governmental levels. The city of Gillette, for example, has had housing developments halted by the state of Wyoming because of inadequate water and sewage treatment facilities.[3] And, in Montana, officials of Miles City have expressed concern about not being able to obtain impact aid from the Montana Coal Board, both because they have been classified a secondary area of development and because they have not been able to finance an updated census.[4]

Problems also emerge among city versus county, and urban versus rural interests. The biggest city-county issue appears to be that costs and benefits of energy development are often distributed inequitably. Most school districts and county governments can expect to have a revenue surplus from property or severance tax receipts since energy facilities are usually located within county and school district rather than municipal boundaries. However, it is the cities which experience the large population increase and are expected to meet immediate needs for housing, water, sewers, and other facilities and services.[1]

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[1] Kutak, Rock, Cohen, Campbell, Garfinkle, and Woodward. A Legal Study Relating to Coal Development, Vol. I: Responding to Rapid Population Growth. Omaha, Neb.: Kutak, Rock, Cohen, Campbell, Garfinkle, and Woodward, 1974, pp. 77-78.

[2] Task Force on Institutional Arrangements, Final Report, for Rocky Mountain Environmental Research, Quest for a Future. Logan, Utah: Utah State University, RMER-QUEST, 1974, p. II-C-I.

[3] "Gillette Warned on Water Woes." Denver Post, July 22, 1976.

[4] Barbara Kennedy, City-County Planner, Miles City, Montana, June 1977. Personal communication.

Urban versus rural conflicts of interest have emerged in Colorado over proposed water transfers from the western to eastern slope. The eastern slope has largely exhausted native supplies of water and are using groundwater resources up to recharge rates, and, therefore, depend on new diversions from the western slope to meet the growing needs of cities such as Denver. Western slope water interests include water for energy development, agriculture, and environmental concerns such as the possibility that diversions will go to areas under consideration for wilderness classification.[2]

E. Indian, State, and Federal Relationships

Indians have been similarly affected by energy and environmental conflict, and relationships between Indians and all levels of government have changed as a result. Indians have become an important participant in the policy system because substantial energy resources are located on tribal reservations.[3] Indian water rights may significantly influence allocation of limited water supplies for every resource development, and Indians have become increasingly concerned about impacts of development such as air quality and social-economic problems.

Because of these factors, tribes have become more organized. They are represented by interest groups such as the Native American Rights Fund, Americans for Indian Opportunity, the National Congress of American Indians, the Council of Energy Resource Tribes (CERT), and the Native American Natural Resource Development Federation. The latter organization represents the Northern Great Plains tribes for the purposes of : (1) defining and describing natural and cultural resources; (2) developing programs to identify impacts of energy resource development; and (3) representing the tribes on federal and state land and water organizations. CERT represents 22 tribes in an effort to form an energy combine which will maximize the benefits of their resources.

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[1] This was found to be the case in the site-specific impact analyses reported in White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977.

[2] Gill, Douglas. "Growth, Water Diversion Aren't Problems of Denver Alone." Denver Post, February 1, 1977.

[3] The 271 Indian reservations in the U.S. are estimated to contain up to one-tenth of the nation's coal reserves and one-sixth of recoverable uranium. Most of these resources are contained on few of the more than 75 reservations located in the eight-state area. See U.S., Federal Trade Commission, Bureau of Competition. Report to the Federal Trade Commission on Mineral Leasing on Indian Lands. Washington, D.C.: Federal Trade Commission, 1975, pp. 8-17.

As is the case for most interest groups, Indians participate largely through the courts. This is especially true regarding definition and quantification of Indian water rights. Indians have been trying to secure their right to total stream flow when that is what is required to meet their needs.[1] They have also sought to remove Indian water rights questions from state court jurisdiction.[2]

Indians have also had an effect on air quality policy, as evidenced by the Northern Cheyenne's success in getting their reservation redesignated to a Class I PSD status, allowing very small additional increments of particulates or sulfur dioxide to the air.[3] Although legal questions still exist about whether energy conversion facilities already under construction will be affected by this redesignation, this is an indication of the potential power of Indian tribes in the system.

2.6 SUMMARY

This chapter has presented a broad-brush overview of the eight-state study area, identifying some of its major characteristics and suggesting how they might affect western energy resource development. The picture which emerges is of a region rich in contrasts: for example, it is rich in natural resources but poor in one of the most essential resources, water; rich in land and energy resources but subject to outside control by the federal government and Indian tribes. It is also sparsely populated, particularly in rural areas where most of the energy resources are located; and populist attitudes prevail, particularly in rural areas where they are reflected in the lifestyle and commitment many westerners have to a frontier-like rugged individualism.

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[1] This right was established in U.S. v. Ahtanum Irrigation District, 236 F. 2d 321, 327 (9th cir. 1956), cert. denied, 352 U.S. 988 (1957).

[2] Two recent cases, Colorado River Water Conservation District V. U.S. and Akin v. U.S., have held that state courts established a system for determining these rights. See McCalister, Elizabeth. "Water Rights: The McCarren Amendment and Indian Tribes' Reserved Water Rights." American Indian Law Review, Vol. 4 (Novmber 2, 1976), pp. 303-10. At the present time, whether these questions are heard in a state or federal court depends largely on the state's water allocation system.

[3] They were the first governmental unit to redesignate certain areas Class I.

This overall regional context will play a significant role in helping to shape the level, pattern, and technologies that will actually be deployed to develop western energy resources. And, as we have seen, so will the energy, economic, and environmental policies discussed in Section 2.3. Finally, the regional context and national and state policies will affect public-private sector and intergovernmental relationships, sometimes in rather fundamental ways. In short, western energy resource development policies will be influenced by a wide range of factors and considerations. Chapters 1 and 2 have discussed only some of the most important of these.

PART II: AN ANALYSIS OF WESTERN ENERGY RESOURCE DEVELOPMENT PROBLEMS AND ISSUES

INTRODUCTION

The first chapter in this part, Chapter 3, describes the Science and Public Policy Program's interdisciplinary team approach to technology assessment as a kind of applied policy analysis and how it was used in the Energy From the West study. Chapters 4 through 12 report the results of analysis of nine categories of problems and issues likely to arrive as a consequence of western energy resource development: water availability, water quality, air quality, land use, housing, growth management, capital availability, transportation, and energy facility siting. Each of these nine chapters summarizes relevant development impacts, describes the social and political context within which they would occur, identifies and describes the problems and issues likely to arise when these development impacts occur in this context, and then identifies, describes, evaluates, and compares policy alternatives for dealing with these problems and issues.

Chapter 13 then provides an overview and summary of the issues and policy responses, organized around five major groups of policymakers: local, state, and the federal government, Indian tribes, and energy developers.

CHAPTER 3

POLICY ANALYSIS IN THE WESTERN ENERGY STUDY

3.1 INTRODUCTION

As indicated earlier, this study is a technology assessment undertaken to identify and analyze a broad range of consequences of energy resource development in the western U.S. and to evaluate and compare alternative courses of action for dealing with these consequences. In this chapter, we describe both our approach to technology assessment as a kind of applied policy analysis and how we have used this approach to attempt to achieve the policy objectives of this "Technology Assessment of Western Energy Development."

3.2. TECHNOLOGY ASSESSMENT AS APPLIED POLICY ANALYSIS

3.2.1 Introduction

Technology assessments (TA) are conducted to achieve two kinds of objectives: first, to inform public and private policymakers and interested citizens about the likely consequences of a decision to develop and operate a technology;[1] and second, to identify, evaluate, and compare alternative policies and implementation strategies for dealing with problems and issues that either are perceived or are actually likely to arise when a technology is actually sited and operated. Three questions must be answered to achieve the first objective of informing policymakers and citizens about consequences:

- Are the anticipated consequences actually likely to occur?

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[1] As used here, the term develop includes research, development, and demonstration. Operate refers to postdemonstration utilization.

[2] The term anticipated rather than perceived consequences is used to emphasize the anticipatory or future orientation of TA research as well as an emphasis of both first and higher order consequences.

- Are there also likely to be consequences which have not been anticipated?

- If either anticipated and/or unanticipated consequences occur, how serious will they be?

To achieve the second objective of identifying, evaluating, and comparing alternatives, the answers to the above three questions must be related to the social and political context within which the technology will be developed and operated. The questions to be answered in this case are:

- What alternative policies and implementation strategies can reasonably be used to maximize benefits and minimize costs and risks when the technology is developed and operated?

- How will these alternatives distribute costs, risks, and benefits throughout society?

3.2.2 Conceptual Framework

A systems diagram of the general conceptual framework used to structure our research effort to answer these five questions in Energy From the West is presented in Figure 3-1. This simplified diagram shows that when a technology is operated, it makes input demands (such as for capital, materials, and labor) and produces outputs (such as electricity, air emissions, and water effluents). When these inputs and outputs interact with the conditions existing at the deployment site (such as ambient air quality, water availability, and the availability of community services and facilities), a range of impacts occur (such as changes in air and water quality and a need for more housing). Some of these impacts are perceived as causing problems and raising issues. When policymakers respond to these problems and issues, they operate under a variety of constraints (such as legal, technical, and political) which affect the feasibility and/or acceptability of alternative policies and implementation strategies.[1]

3.2.3 Interdisciplinary Core Team Approach

To implement this framework, the analytical skills and perspectives of multiple disciplines are required. We have taken an interdisciplinary core team approach to insure a range of skills and perspectives; and we have used procedures which provide for

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[1] This general conceptual framework is discussed in more detail in White, Irvin L., et al. First Year Work Plan for a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1976, Chapter 2.

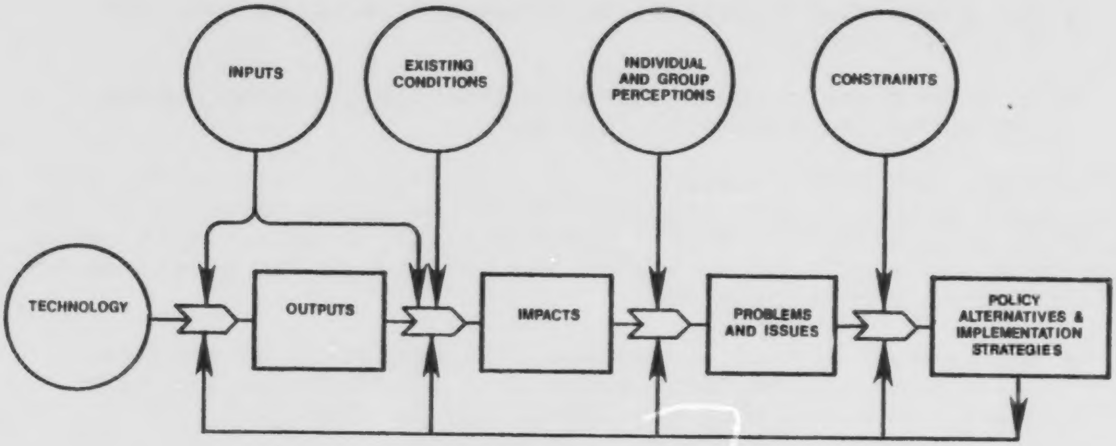
INPUTS
EXISTING CONDITIONS
INDIVIDUAL AND GROUP PERCEPTIONS
CONSTRAINTS
TECHNOLOGY
OUTPUTS
IMPACTS
PROBLEMS AND ISSUES
POLICY ALTERNATIVES & IMPLEMENTATION STRATEGIES

FIGURE 3-1: A CONCEPTUAL FRAMEWORK FOR ASSESSING PHYSICAL TECHNOLOGIES

all research team products to be processed through several drafts, each of which is subjected to an intensive critical review by the core team and then redrafted. The product of this internal review process is still considered a draft and is subjected to extensive external critical review by an advisory committee, subcontractors, consultants, and a broad range of interested parties or stakeholders.

Internal reviews are intended to bring the team's collective knowledge, analytical skills, and perspectives to bear on the technology assessment topic and to produce a well-informed, technically correct, reasonably comprehensive, and, to the extent possible, unbiased team product. The external reviews have two major purposes: first, to involve potential users of the team's products in the research in order to increase the likelihood that the results of the TA will be useful and used; and second, to provide a means for insuring that the team's final products are as well informed, technically correct, adequately comprehensive, and unbiased as possible.[1]

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[1] This interdisciplinary core team approach is described in more detail in White, Irvin L., et al. First Year Work Plan for a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1976; Kash, Don E., and Irvin L. White. "Technology Assessment: Harnessing Genius." Chemical and Engineering News, Vol. 49 (November 20, 1971), pp. 36-41; and White, Irvin L. "Interdisciplinarity," in Arnstein, Sherry, and Alexander N. Christakis, eds. Perspectives on Technology Assessment. Columbus, Ohio: Academy for Contemporary Problems, 1975, pp. 87-96.

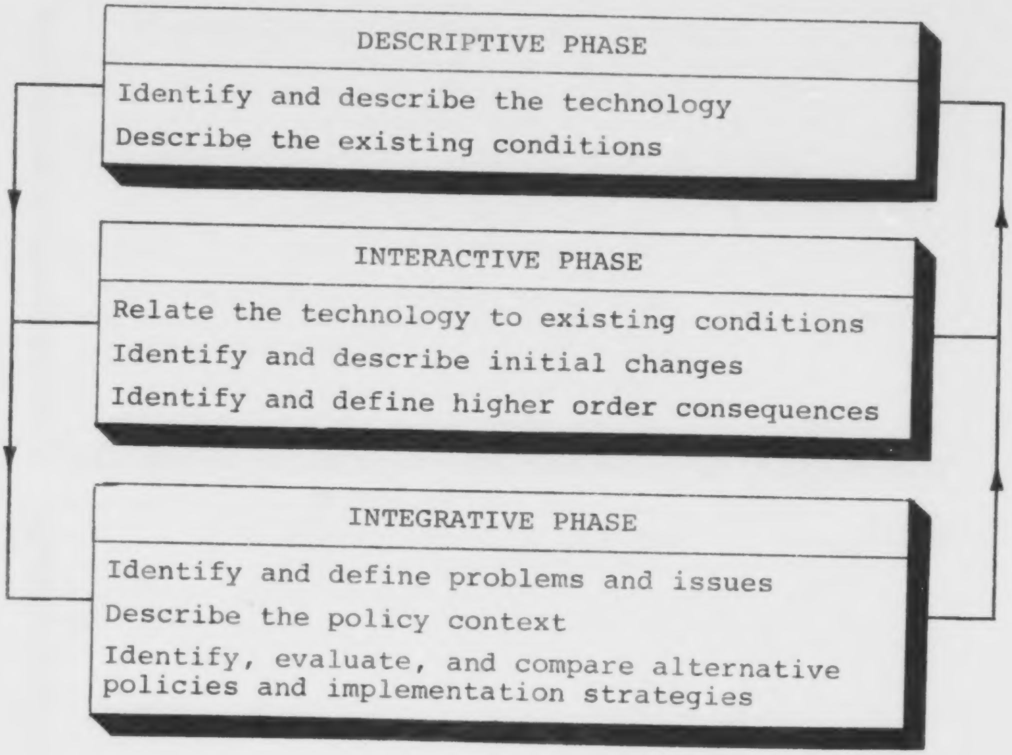
DESCRIPTIVE PHASE
Identify and describe the technology
Describe the existing conditions
INTERACTIVE PHASE
Relate the technology to existing conditions
Identify and describe initial changes
Identify and define higher order consequences
INTEGRATIVE PHASE
Identify and define problems and issues
Describe the policy context
Identify, evaluate, and compare alternative policies and implementation strategies

FIGURE 3-2: THE PHASES OF A TECHNOLOGY ASSESSMENT

In addition to providing the variety of expertise, analytical skills, and disciplinary perspectives required for a TA, the interdisciplinary team approach also helps to temper what could become an excessive analytical formation. The three phases described here and the procedural steps for performing the tasks in each phase are not nearly so sequential and formal as they might appear. We purposely employ the creative tensions generated within the core research team and the extensive internal and external review process briefly described above to prevent the research effort from becoming a rote, box-filling exercise.

3.2.4 The Phases of a Technology Assessment

The tasks that must be completed when the general conceptual framework shown in Figure 3-1 is operationalized can be divided into three categories: Descriptive, Interactive, and Integrative (see Figure 3-2).

STEP I

IDENTIFY AND DESCRIBE THE TECHNOLOGY

For the single process (such as Lurgi gasification) or a combination of processes (such as coal mining, power generation, and high voltage transmission), specify:

1. Input requirements--water, capital, manpower, and materials, for example;
2. Outputs or residuals--high-Btu gas, SO_2, NO_x, particulates, sludge, liquid wastes, and noise, for example;
3. Social controls--such as permits and standards

STEP II

DESCRIBE EXISTING CONDITIONS

For the site or area within which the technology is to be deployed, describe existing conditions, including, among others:

1. Topography and geology
2. Climatology
3. Ecology
4. Social infrastructure
5. Sectors of economic activity
6. Land-use patterns
7. Active parties-at-interest
8. Problems and issues
9. Policymaking systems

FIGURE 3-3: THE DESCRIPTIVE PHASE

A. The Descriptive Phase

In Energy From the West, products of the Descriptive Phase characterize both the technologies expected to be used to develop western energy resources and the conditions existing in the vicinity of the sites where these technologies might be operated (see Figure 3-3). Technologies for the development alternatives briefly described in Chapter 1 of this report are described in more detail in Energy From the West: Energy Resource Development

Systems Report.[1] The resource base, technological alternatives, input requirements, product and residual outputs, economic costs, energy efficiencies, and resource-specific laws and regulations for each of the six resources being considered in Energy From the West are described.

The descriptions of existing conditions at six sites and for the entire eight-state area more generally are presented in Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development[2] and Energy From the West: Final Impact Analysis Report.[3] The six sites identified in Chapter 1 above were chosen because they appear to be representative of the sites where energy development is either taking place or is likely to take place in the eight-state area in the future.

B. The Interactive Phase

These descriptions of the technologies and sites are the source of most of the data base needed for an analysis of the impacts of deploying a particular technology or some combination of technologies at a specific energy development site or of developing specified quantities of energy within the eight-state study area. These are Integrative Phase analyses (see Figure 3-4). In Energy From the West, site-specific impacts in four major categories have been analyzed: Air Quality, Water Quality and Availability, Socioeconomic, and Ecology. In addition, certain local impacts which are not particularly site-specific or which are highly speculative because of the inadequacy of existing knowledge, data, and/or analytical tools have also been analyzed. The results of these analyses are reported in the Energy From the West progress and final impact analysis reports mentioned earlier. The results of our more general regional and national impact analyses are also reported in these two reports. In addition to the four categories listed above, Aesthetic, Health Effects, Transportation, and Noise Inputs were analyzed at the regional level. The steps followed in performing these Interactive Phase analyses are shown in Figure 3-4.

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[1] White, Irvin L., et al. Energy From the West: Energy Resource Development Systems Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[2] White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977.

[3] White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

STEP I

DETERMINE INITIAL CHANGES IN EXISTING CONDITIONS

Determine the changes likely to occur when the technology is constructed, operated, and shutdown, for example, changes in:

1. Air quality
2. Water quality
3. Water availability
4. Population
5. Land use

STEP II

IDENTIFY AND ANALYZE HIGHER ORDER CONSEQUENCES

Trace impacts to identify higher order consequences, for example, consequences for:

1. Human health
2. The availability of social services and facilities
3. Sectors of economic activity
4. Quality of life
5. Power structure
6. Habitat attrition

FIGURE 3-4: THE INTERACTIVE PHASE

C. The Integrative Phase

Together the Descriptive and Interactive Phases are intended to provide results which make it possible to evaluate and compare technologies and potential energy developments on the basis of objective and, to the extent possible, unbiased, scientific and technical criteria. The descriptions of energy development technologies and locations and the results of the analyses of impacts likely to occur when technologies and locations are interacted can be used to inform policymakers about the costs, risks, and benefits of various technology and siting options for western energy resource development. For example, on the basis of these technical analyses, policymakers can make better informed choices about which technology-location combinations to encourage or discourage or to permit or prohibit in order to achieve their objectives within what they consider to be acceptable limits of costs and risks. But the results of technical analyses such as these, including ours in Energy From the West, are almost always incomplete, largely because of the limited explanatory power of existing theories and either the inadequacy or unavailability of data and analytical tools.[1] But even if it were possible to overcome these limitations, the results of these technical analyses would not be an adequate basis for policymaking. Policymakers need to know more than the results of these analyses tell them. They need to know how costs, risks, and benefits identified by the technical analyses will be distributed, which interests and values in society will be promoted at the expense of which others, how to promote the interests and values they wish to promote, and how to avoid unwanted costs and risks. Providing policymakers this kind of information is the objective of the Integrative Phase of a TA. Given the focus of this report, the Integrative Phase of Energy From the West is described in more detail than were the Descriptive and Interactive Phases.

3.2.5 Policy Analysis in the Integrative Phase

A. The Three Steps in Policy Analysis

The policy analyses in Energy From the West are being conducted in three steps:

- The identification and definition of problems and issues;
- The description of the policy context within which the development and operation of the technology will occur;
- The identification, evaluation, and comparison of alternative policies and implementation strategies.

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[1] The limitations of our analyses will be described in detail in a forthcoming research needs report.

(1) The Identification and Definition of Problems and Issues[1]

Some problems and issues associated with the development and operation of a technology in the western U.S. were identified by the team when the conditions existing at the time and location of deployment were being described. That is, some problems and issues were anticipated independently of the technical analyses described in Section 3.2.1, in some instances on the basis of analysis, but often on the basis of past experience, analogy, and informed speculation. However, some problems and issues were not anticipated; consequently, as shown in Figure 3-5, a beginning step in policy analysis was for the interdisciplinary research team to review systematically the results of the technical analyses to guard against otherwise unanticipated consequences being overlooked. Others were added or redefined as a result of the policy analyses themselves.

IDENTIFY AND DEFINE PROBLEMS AND ISSUES

Define problems and issues:

- already identified and being discussed by participants in the policy system
- identified by the interdisciplinary research team

FIGURE 3-5: POLICY ANALYSIS: STEP 1

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[1] The terms "problems" and "issues" are not synonyms. Problems such as those resulting because of the labor and capital intensity of a technology may or may not lead to an issue being raised. The key distinction is that issues involve conflict among competing interests and values. Not all problems produce conflicts, consequently, both terms must often be used. This frequently is awkward, and in this chapter only one or the other will ordinarily be used, "problem" when conflict is not involved or is not being emphasized, "issue" when it is.

(2) The Description of the Policy Context

In the second policy analysis step, both anticipated and unanticipated problems and issues are related to the social and political context within which the development and operation of the technology is expected to take place. This requires that the relevant policy system or systems be identified and described in substantive terms.[1] The interests and values at stake, relevant institutional arrangements, applicable laws and regulations, governmental and nongovernmental participants, and intensity of involvement of various participants can vary on the basis of the substance of the problem.

For issues that the political system has dealt with in the past, the identification of the issue system begins with an examination of key elements in the historical development of the issue: when did the issue arise; which participants in the system perceived that it was an issue and what interests and values did they represent; when did government respond; how did government respond and what policies were enacted; who administers these policies; and, how have these policies affected the issue? This step also includes a more detailed identification and description of the existing system for dealing with the issue: what are the relevant current public and private, formal and informal institutional arrangements; what interests and values are at stake, who represents them and what strategies and tactics are they employing; and, are there situational or social and physical environmental conditions and circumstances that either affect or could potentially affect whether and how the issue is processed?

The procedural steps the team used in describing the development and deployment context in Energy From the West are outlined in Figure 3-6.[2]

One essential task in this step in policy analysis is the identification of the interests and values that are at stake. Given the range of interests and values potentially at stake and

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[1] This "issue systems" approach is based on the observation that political systems vary according to the substance of the issue being processed. An issue system may be defined in terms of a single issue such as what the ambient concentration standard for sulfur dioxide should be, or on a category of problems and issues such as air quality.

[2] Not all of the items listed here apply to all problems and issues. Which of them apply is determined by the stage of development of the problem or issue. Some will be "well developed," and all of the listed items will be applicable; others will be just emerging or not yet anticipated independently of the TA and few, if any, of the listed items will be applicable.

DESCRIBE THE POLICY CONTEXT

- Describe the key elements in the historical development of the issue:
  - When did the issue arise?
  - Which participants in the system perceived it as an issue?
  - What interests and values did these participants represent?
  - When and how did government respond?
  - What policies were enacted or established?
  - What agency administered these policies?
  - How have these policies affected the issues?
- Describe the existing policymaking system or systems for dealing with the issue:
  - What are the relevant, current public and private, formal and informal institutional arrangements and processes?
  - What interests and values are at stake?
  - Who represents these interests and values and what strategies and tactics are they using?
  - How is the problem or issue being dealt with by the existing policymaking system?
  - Are there situations or social and physical environmental conditions and circumstances that either affect or could affect whether and how the issue is processed by the system?

FIGURE 3-6: POLICY ANALYSIS: STEP 2

the numerous ways they can be categorized, this is a difficult task to perform systematically and comprehensively. As an aid in performing this task, we constructed the interest and value checklist presented in Table 3-1.[1] We also used a checklist of the categories of interests and values most likely to be in conflict

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[1] Clearly this list is inadequate for any purpose other than to encourage the researcher to search broadly when taking an interests and values inventory. This was how we used the list; and we found the list to be helpful even though it contains apples and oranges.

TABLE 3-1: INTEREST AND VALUES CHECKLIST

SOCIAL	ECONOMIC	ENVIRONMENTAL	POLITICAL/INSTITUTIONAL
Quality of Life -Educational Opportunities -Health Care -Housing -Utilities -Recreational Opportunities -Public Safety -Aesthetics -Comfort -Lifestyle -Leisure Stability/Certainty Equity Health -Occupational -Public Conservation Safety -Occupational -Traffic Security/Crime -Personal -Community Autonomy -Independence/Freedom Cultural Moral/Ethical Religion Ethnicity Personal Efficacy Heritage -Artifacts and Sites -Lifestyle -Mores -Resources Status	Economic Opportunities -Employment -Small Business -Corporate Personal Income Public Revenues -Taxes -Fees/Transfers Property Values Cost-of-Living Inflation Economic Well-Being -Lifestyle -Security -Status Economic Sectoral Changes -Manufacturing -Agriculture -Other Extractive -Service -Government Economic Growth -Local -Regional -National Competition for -Labor -Resources	Aesthetics -Air Quality -Water Quality -Land Forms -Rivers and Streams -Visual Intrusions -Noise -Odors -Wildlife/Plants Physical Alterations -Air Quality -Water Quality and Availability -Land-Use Changes -Rivers and Streams -Weather Modification -Visibility Archeological Sites and Artifacts Parks and Recreational Areas Unique or Rare Species and Habitat Toxics and Hazardous Substances Population Density Stability Diversity Production Open Space	Public Participation -Leadership -Access -Personal Power and Efficacy Ethnic Identity -Self-Determination -Control over Communal Property and Resources -Intergovernmental Relations Autonomy -Community -State -Regional -Organizational Stability -Leadership -Rules of the Game -Planning Capability -Organizational Inertia Interdependence Regulation and Control Public/Private Ownership Complexity/Simplicity Good Government Partisanship

TABLE 3-2: MAJOR POTENTIAL INTEREST AND VALUE CONFLICTS

CATEGORIES OF INTERESTS AND VALUES POTENTIALLY IN CONFLICT
Economic Growth v. Environmental Quality
Energy v. Environment
Clean Air v. Health
Autonomy/Independence v. Regulation/Control
Stability v. Change
Conservation v. Production
Public v. Private
Economic Sector v. Economic Sector

as a consequence of western energy resource development. This list is presented in Table 3-2. Neither list is altogether satisfactory and considerable resources could be expended to improve them. We found them to be useful despite their limitation and did not believe that the benefits of an incremental improvement to be great enough to warrant expanding the resources.

(3) The Identification, Definition, Evaluation, and Comparison of Alternative Policies and Implementation Strategies

In the third policy analysis step, policy alternatives and implementation strategies are being identified, defined, evaluated, and compared. Alternatives and implementation strategies for dealing with issues already being processed by the system were identified in step two above. However, the interdisciplinary research team has also formulated alternatives itself, both for issues already being processed and for problems and issues likely to arise as a consequence of unanticipated impacts identified when the results of our technical analyses were reviewed. Drawing from both sources, the team has reduced the number of alternatives and strategies to be evaluated and compared in detail to a manageable number.[1] As described in our First Year Work Plan,[2] this was accomplished by applying a number of filters to isolate alternatives and strategies that appear to be most significant and feasible. Since alternatives distribute costs, risks, and benefits differently, the filtering of alternatives required at least a preliminary assessment of what the distributive effects of each alternative would be. For example: (1) which individuals, groups, or organizations would benefit more than or at the expense of others; (2) which costs, risks, benefits would be transferred from some individuals, groups, or organizations to others; and (3) would existing regulations have to be modified, eliminated, or new regulations have to be added to existing programs, or would new regulatory programs have to be established? A detailed evaluation and comparison of all possible alternatives is not feasible and is being limited to the few alternatives which survive the internal and external review processes mentioned earlier (see Figure 3-7).

To structure the formulation, evaluation, and comparison of the selected alternative policies and implementation strategies, the Science and Public Policy (S&PP) interdisciplinary team identified:

- The policy objectives to be achieved in each problem or issue category;
- Categories or kinds of alternatives that could be used to achieve each objective;
- Specific alternatives within each category;
- How each specific alternative might be implemented;
- The implications of choosing and implementing each alternative and strategy.

A table similar to that shown in Table 3-3 was used in each chapter to provide the reader a convenient reference for organizing the introduction and general description of alternatives. The

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[1] The selection from among all possible alternatives (or all that team members can identify) was necessarily arbitrary. There are two major checks on this arbitrariness: first, the interdisciplinary team reviews the inputs of individual team members; and second, the team's collegial products are subjected to extensive external reviews. As noted earlier, both internal and external review help to minimize bias, factual and interpretative errors, and errors by oversight.

[2] White, Irvin L., et al. First Year Work Plan for a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1976.

IDENTIFY, EVALUATE, AND COMPARE ALTERNATIVE POLICIES AND IMPLEMENTATION STRATEGIES

- Identify and describe alternative policies and implementation stragegies already being proposed for dealing with existing problems and issues;
- Describe alternative policies and implementation strategies formulated by the interdisciplinary research team;
- Reduce the number of alternative policies and implementation stragegies to a manageable number by identifying those which are most significant and feasible.
  - Filter the complete list of alternative policies and implementation strategies by conducting a preliminary evaluation of how they distribute costs, risks, and benefits;
  - Identify the barriers or constraints (e.g., legal, ethical, moral, difficulty of implementation, economic, etc.) to acceptance and implementation;
- Describe the costs, risks, and benefits of each alternative and implementation strategy:
  - Which individuals, groups, or organizations would benefit more than or at the expense of others?
  - Would existing regulations have to be modified, eliminated, or new regulations added to existing programs or would a new program have to be established?
- Compare alternatives and strategies on the basis of explicit criteria using a variety of measures.
- Submit the team's evaluation and comparison of alternatives and strategies to external review.

FIGURE 3-7: POLICY ANALYSIS: STEP 3

TABLE 3-3: WATER AVAILABILITY ALTERNATIVES

OBJECTIVE	GENERAL ALTERNATIVE	SPECIFIC ALTERNATIVE
Meet the needs of water users	Increase water supply (augmentation)	Surface water diversion, transfer, and storage Interbasin Intrabasin Groundwater storage Groundwater use Weather modification Vegetation management Runoff modification Remove nonproductive vegetation
	Increase use of existing supply (conservation)	Conservation for energy resource development Choice of technology Cooling and process designs Municipal wastewater for cooling Conservation for agriculture Irrigation efficiency improvements Crop selection Conservation for municipalities
Meet only a part of total water needs	Decrease or eliminate some uses	Decrease or eliminate water-intensive agriculture Decrease or eliminate water-intensive energy development

entries in Table 3-3 are from the table used in the analysis of water availability problems and issues in Chapter 4. These entries illustrate how this procedure was operationalized.

For example, if policymakers choose to try to meet the expanded needs of water users, one general alternative for accomplishing this objective is to increase the use of existing supplies. Specific options within this general alternative include forced conservation by energy industries, by irrigated agriculture, and by municipalities. Each of these options has a variety of specific implementation strategies which can be carried out by several levels of government and with various implications for environmental quality, cost of energy products, etc. Focusing on this sequence of questions helps to systematically structure the analysis of policy alternatives. Of course, at each step considerably more detail is added.

A separate table in these chapters elaborates the implementation strategy, identifying and describing specific strategies for each alternative and how each alternative might be constrained by political/economic, environmental, or other considerations. Again the objective is to provide the reader a convenient reference to follow when various implementation strategies are described.

B. Criteria for Evaluating and Comparing Alternatives

While the results of the policy analyses described above will seldom if ever eliminate the uncertainties that public and private policymakers face in making decisions to develop and deploy technologies, these results can help them to make better informed choices than they would otherwise be able to make. Results of policy analyses are useful in this regard to the extent that they systematically describe, evaluate, and compare alternatives using clearly specified criteria and appropriate qualitative and quantitative measures; indicate theoretical, data, and analytical tool limitations; and specify confidence levels.

The five basic criteria used in the evaluation and comparison of alternative policies and implementation strategies in Chapters 4-11 are listed in Table 3-4. Each criterion has to be defined more specifically for the category of problems and issues being evaluated and compared. And specific qualitative and quantitative measures have to be specified for each. For example, as applied to water availability, effectiveness is defined in terms of how much water an alternative would save or add, whether it would avoid or mitigate the problem, and whether it would offer a long- or short-term solution. Among the quantitative measures used in this case are gallons or acre-feet per year saved or added, the percentage increase in supply, and the duration of the solution in time (years, months); the anticipated degree to which the problem is avoided or mitigated is an example of a qualitative measure in this instance.

TABLE 3-4: EVALUATION CRITERIA

CRITERION	WHAT DOES IT EVALUATE?
Effectiveness	Achievement of Objective Avoid or mitigate the problem or issue? Short- or long-term resolution or solution? Dependency on state-of-society assumptions?
Efficiency	Costs, Risks, and Benefits Economic costs, risks, benefits? Social costs, risks, benefits? Environmental costs and risks? Reversible/irreversible, short- or long-term?
Equity	Distribution of Costs, Risks, and Benefits Who will benefit? experience costs? assume risks? - Geographically? - Sectorially? - Socially?
Flexibility	Applicability/Adaptability Are local and regional differences accommodated? Are social and sectorial differences taken into account? How difficult will it be to administer? How difficult will it be to change?
Implementability	Adoptability/Acceptability Can it be implemented within existing laws, regulations, and programs? Can it be implemented by a single agency or level of government? Is it compatible with existing societal values? Is it likely to generate significant opposition?

The basic point about measures is that while many policymakers desire to have a "bottom line," no single measure or evaluation criterion can provide an adequate summary of the costs, risks, and benefits of alternative policies and implementation strategies.[1] The combination of measures and criteria to be used is determined both by what is being evaluated and the interests and values that are at stake. Although economic measures and criteria are used most frequently, they are not always applicable and do not always provide an adequate basis for evaluation. For example, dollars are not an adequate measure of aesthetic values nor do they always provide the best indication of how equitably an alternative may distribute costs, risks, and benefits. And while it is possible to determine the dollar cost of environmental controls, the associated social costs often cannot be determined. By themselves, economic measures and criteria can be used to evaluate only one component of overall costs, risks, and benefits.

C. A Summary of the Evaluation and Comparison of Alternative Policies and Strategies

The desired end product of these policy analyses is a summary of costs, risks, and benefits which, to the maximum extent possible, inform policymakers about the consequences of their policy choices. We expect to be more advanced in this stage of our analysis in the final policy analysis report than we are in this draft.

D. Integrating the Results of Policy Analyses

Results of analyses must be summarized across problem or issue categories and integrated on a geographical, level of government, and other appropriate basis. Chapter 13 provides this summary and integration in this report.

E. Utilization

Utilization activities are an integral part of the approach to TA described in this chapter. Extensive contacts are established and maintained with germane government agencies and officials, and participants in the policy systems being studied. In addition to the external review process described above, this has involved a good deal of field work and formal and informal communication, including meetings and presentations in the eight-state study area and in Washington as well as continuing contact by telephone and correspondence. We believe that this participatory approach to TA provides two major benefits: first, by involving potential users of our reports in our research, they are more likely to find our work useful; and second, the research team helps to develop a communication link among participants in the policy systems being studied. Given the nature of our federal system, and the complexity of many of the problems policymakers have to deal with, it is difficult to introduce research results into the policymaking system effectively. The S&PP research team's efforts to insure successful and effective utilization will be a major continuing activity during the fourth year of the project.

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[1] We have discussed the use of multiple measures and evaluation criteria in Chapter 5 of White, Irvin L., et al. First Year Work Plan for a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1976.

CHAPTER 4

WATER AVAILABILITY

EXECUTIVE SUMMARY

Water availability problems and issues are among the most critical associated with western energy resource development. As energy resources are developed during the next several decades, water supplies are likely to be inadequate to meet increased demands of water users. Shortages are likely to intensify existing political conflicts over how resources will be allocated and who will pay the costs, receive the benefits, and assume the risks of water resource policies.

Impacts

Findings from our analysis of impacts suggest that:

- Electric power generation consumes more water than does any other conversion technology on a per unit of energy produced basis, assuming a high level of wet cooling (Figure 4ES-1).

- Among synthetic fuel technologies considered, Synthane gasification may demand 25 to 60 percent more water than Lurgi gasification and more than any other synthetic fuel technology to produce the same amount of energy (Figure 4ES-1).

- Process water requirements are generally very small compared to water lost to evaporation in cooling towers. Assuming wet cooling is used, cooling is the largest single water requirement for both electric power plants and synthetic fuel facilities, representing about 50 to 95 percent of the total water requirements.

- If water-saving cooling technologies are used, water requirements for electric power plants can be reduced about 60 to 90 percent and requirements for synthetic coal facilities can be reduced about 40 to 95 percent.

- Siting alternatives can affect water consumption because of the moisture and British thermal unit (Btu) content of the coal. For example, water requirements for a Lurgi

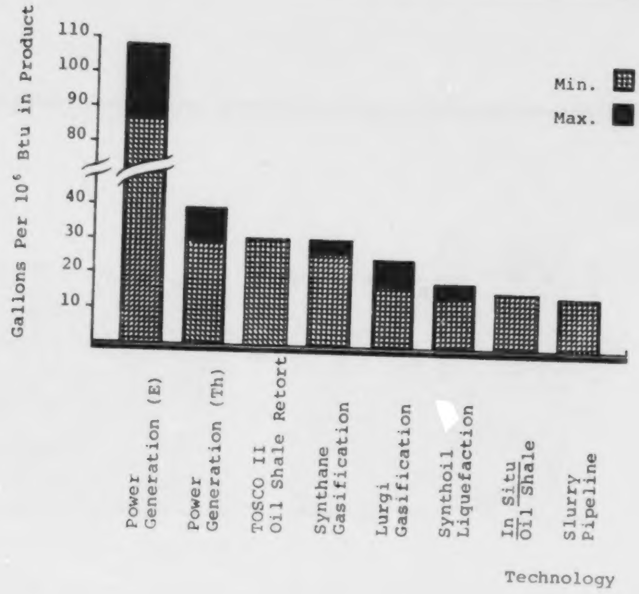

Figure 4ES-1: Water Requirements For Energy Conversion Technologies

gasification facility can be 40 percent lower in the Northern Great Plains than in the Four Corners area.

- Water for mine reclamation and new municipal demands range up to 10 percent of the water required for conversion facilities. However, municipal demands still create local water shortages if new treatment and distribution systems are required.

Depending on technologies and sites chosen, western energy resource development may create local and possibly regional water shortages. On a basinwide level, the most severe problems are likely to occur in the Upper Colorado River Basin. When energy requirements for water are added to nonenergy requirements for the year 2000, the total may exceed minimum availability estimates by as much as one million acre-feet per year (acre-ft/yr) (Figure 4ES-2). Even using the most optimistic combination of these estimates of water requirements and availability, energy resources development will consume a large percentage of available surface water, and thus, heighten existing conflicts over appropriate water uses.

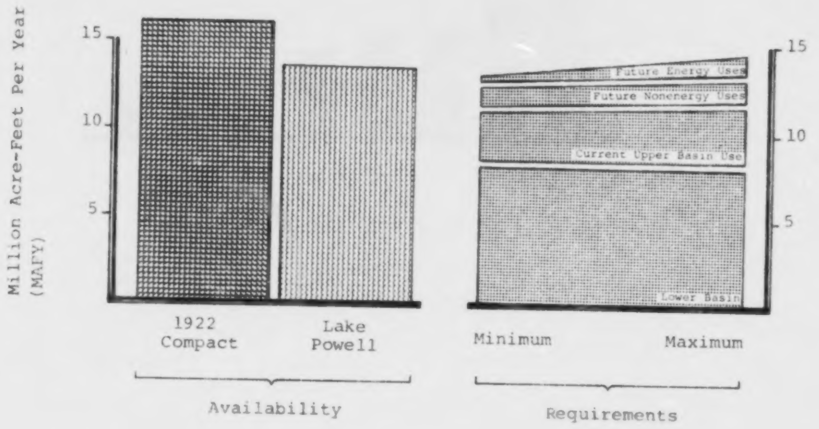

Figure 4ES-2: Projections of Water Requirements and Availability in Colorado River - Year 2000

Water availability does not appear to be a problem in the Upper Missouri River Basin as a whole, since water not already allocated is well in excess of maximum anticipated requirements. However, some energy resources are located close to stream segments already subject to conflict over beneficial use of water, as is true for the Yellowstone River. Further, much energy development will occur in areas distant from surface water supplies and necessitate pipelines or other means of water transfer.

Groundwater is also available in both river basins and in some cases might be an alternative water source for energy development facilities and related populations. However, relying on groundwater will also produce problems, particularly if it is mined (consumed faster than the aquifer from which it is being withdrawn is recharged) or affects surface stream flows.

The Policy Context

Competition for water and concern for its quality have led to a complex regulatory system--including international treaties, interstate compacts, state appropriation systems, conflicting court decisions, and unanswered questions such as the quantification of federal and Indian reserved rights and the value of water from federal projects. Together with the complex physical controls on western water systems (dams, impoundments, and diversions), the regulatory system has generally promoted two primary interests:

- Downstream users, who attempt to maximize guarantees of supplies, for example to states of the lower Colorado and lower Missouri River basins;
- Irrigated agriculture, a basic industry in each of the eight states often dependent on water supplies from distant sources.

However, these traditional interests have been seriously challenged recently by interests representing energy development, environmental values, Indian nations, city and county government, and others. Competition among these interests in conjunction with the complexity and ambiguity of the regulatory system suggest that the following water availability issues are likely to occur:

- Energy resource development, particularly on-site conversion of resources, may be restricted in many areas of the West, especially in the Upper Colorado River Basin. This situation would create barriers to the National Energy Plan and mean a loss of economic benefits to western states and municipalities.
- Environmental resources may be damaged as stream flows are increasingly depleted to meet the needs of industrial, agricultural, and municipal uses. Threatened environmental values include loss of recreational uses, habitat damage from reduced flows and wetlands removal, and damage to scenic and aesthetic values.
- Restricted development of Indian lands and/or damage to Indian values and culture may occur if Indians are denied adequate water supplies. This could reduce overall energy development by impeding the utilization of extensive resources located on Indian lands and would further complicate the legal and political problems.

- Irrigated agriculture could be restricted or eliminated in many areas of the West if existing water resources are diverted for use in energy resource development. Since this situation would change the basic economic structure and threaten many western values, political conflicts would almost certainly increase between the federal and state governments, among regions, and among states in the West.

Alternative Policies

Policymakers can seek two kinds of policy objectives in dealing with water availability problems and issues: first, to try to meet the expanded needs of water users; and second, to meet only a part of those needs by redistributing supplies.

As shown in Table 4ES-1, two general categories of alternatives can be used to attempt to achieve the objective of meeting the expanded needs of water users:

- Increase water supply (augmentation);
- Increase the use of existing supply (conservation).

TABLE 4ES-1: WATER AVAILABILITY ALTERNATIVES

POLICY OBJECTIVE	CATEGORY OF ALTERNATIVE	SPECIFIC ALTERNATIVE
Meet the needs of water users	Increase water supply (augmentation)	Surface diversion, transfer, and storage Groundwater storage Groundwater use Weather modification Vegetation management · runoff modification · remove nonproductive vegetation
	Increase use of existing supply (conservation)	Conservation for resource development · choice of technology · cooling and process designs · municipal wastewater for cooling Conservation for agriculture · irrigation efficiency improvements · crop selection Conservation for municipalities
Meet only a part of total water needs	Limit or eliminate some uses	Limit or eliminate water-intensive agriculture Limit or eliminate water-intensive energy development

Increasing water supply has been the traditional response to water availability problems in the West. This policy approach could be continued by adopting specific augmentation alternatives such as intrabasin diversions and transfers and increased storage in surface impoundments. Existing water supplies can also be augmented by other alternatives such as interbasin transfers, groundwater storage, weather modification, and managing natural vegetation. In order to meet expanded needs of water users, policymakers may also choose to improve the use of existing supplies through conservation in energy resource development, irrigated agriculture, municipal, and industrial uses.

Policymakers may take a much different approach by meeting only a part of future water needs. By choosing this objective, policymakers explicitly acknowledge that water supplies are inadequate and that available supplies need to be allocated to those uses most valued in specific areas. As suggested in Table 4ES-1, this objective can be achieved by limiting or eliminating water-intensive uses, including both energy resource development and irrigated agriculture.

Findings

Substantial quantities of water can be added to existing supplies if both augmentation and conservation are employed extensively, perhaps enough to avoid water shortages in many areas of the West. Effective augmentation choices to achieve this goal, potentially capable of adding millions of acre-ft/yr, include interbasin transfers, weather modification, and vegetation management. Conservation alternatives appear generally less effective than augmentation, and considerable uncertainty is associated with estimating the effects of each alternative. However, conservation for energy facilities by employing water-efficient cooling technologies can save about 400,000 acre-ft/yr by the year 2000.

Although augmentation and conservation alternatives can potentially supply large quantities of water, many of the specific alternatives are likely to produce unacceptable consequences to many stakeholders. Several alternatives will produce substantial environmental costs and risks. This is more likely to be the case for augmentation, particularly for transfers (interbasin and intrabasin), impoundments, and vegetation management. In contrast, environmental benefits, largely associated with preserving instream flows, are derived from most conservation alternatives.

If used extensively, augmentation and conservation would also result in significant economic costs. In fact, because of their economic costs many alternatives appear to require federal subsidies. This is especially true for transfers, impoundments, underground storage, and conservation in irrigated agriculture, largely because of construction costs. The most effective conservation option, mimimum wet cooling for energy facilities, is very expensive for the amount of water saved. Intermediate wet cooling can save almost as much water and is more cost-effective.

Economic and environmental risks contribute to political problems for several alternatives. For example, interbasin and intrabasin transfers create inequities for the donor basins or subbasins. In fact, perception of such inequities has already created legal barriers to interbasin transfers from the Columbia River system, and generated conflict between west and east slope interests in Colorado. Equity problems are also important for conservation alternatives, since irrigated agriculture in general may not be able to afford the capital costs of more efficient mechanical irrigation systems. Because irrigated agriculture is already heavily subsidized, additional federal support is likely to require local and state cost sharing in order to remain feasible.

Political questions are also likely to arise over the flexibility of many of these alternatives. Because water availability problems depend on many locational conditions, and western states have increasingly demanded more control over their own growth, future water policy will probably require responses which account for western values and can be applied according to local conditions. However, these considerations will make it more difficult to adopt equitable responses, to the extent that policymakers opt for alternatives which apply uniform standards or attempt to distribute costs, risks, and benefits equitably among states and sectors of society. Hence, there will be strong pressures for flexible alternatives which can be applied to locational conditions, such as weather modification. Our analysis also highlights the importance of implementation strategies to apply policy responses to locational circumstances. For example, wet/dry cooling might best be implemented by imposing location-dependent ceilings on water use rather than requiring a uniform technology.

Conclusion

This evaluation does not lead to the identification of one category of alternatives that is superior to all others--in fact, a mix of policy alternatives will probably be required to address the complex problems of water resource development. This is in part because of the lack of adequate information about water problems and policy alternatives. However, it is also because of the nature of water availability problems and issues, which incorporate a wide range of interests and values and critically affect growth and development on a region-wide basis. It is not at all clear that the regulatory system as currently constructed is capable of addressing these complex issues in a comprehensive and timely manner, other than by letting events and ad hoc, incremental decisions shape policy. This approach will almost certainly deprive some interests and values, particularly those of irrigated agriculture, if economic considerations dominate. If policymakers choose to try to meet water needs rather than explicitly eliminating some uses, this evaluation suggests that intermediate wet cooling technologies for energy conversion facilities, weather modification, groundwater storage, and selective vegetation management can add or save substantial quantities of water while minimizing many adverse consequences.

CHAPTER 4

WATER AVAILABILITY

4.1 INTRODUCTION

Water availability can seriously constrain large-scale energy resource development in the West, particularly coal and oil shale conversion and development within the Upper Colorado River Basin (UCRB). Competition for water is already keen and energy development will add another major competitor, worsening existing political conflicts over how and to whom water resources are allocated. These conflicts are, in part, a product of uncertainties associated with the existing complex system of appropriated rights, interstate compacts, international treaties, and court decisions as well as numerous unanswered questions about prior rights, beneficial uses, and linkages between ground and surface water. But the basic underlying causes of water problems and issues are its scarcity throughout the region, the inadequacy of water resources data, particularly on groundwater, and the multiplicity of political jurisdictions involved.

This chapter focuses on water availability problems and issues. In the following section, the impacts of energy resource development on water availability, reported in detail in our Energy From the West progress and impact analysis reports,[1] are summarized and related to the social and political context within which western energy resource development will take place. This includes identifying the interests and values which are at stake, the stakeholders or parties-at-interest who represent and promote them, and the existing systems and processes for dealing with water availability problems and issues. Relating water availability impacts to the context within which development will take place leads to the identification and definition of the significant water availability problems and issues that policymakers are likely to have to deal with as a consequence of energy resource development. These problems and issues are summarized in Section

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[1] White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977; and White, Irvin L. et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

4.2.3, and Section 4.3 identifies, evaluates, and compares alternative policies and implementation strategies for dealing with them.

4.2 WATER AVAILABILITY PROBLEMS AND ISSUES

4.2.1 The Water Availability Impacts of Energy Resource Development

A. Impacted Waters

Figure 4-1 shows the major surface waters in the eight-state study area likely to be affected by energy resource developments considered in the Energy From the West. The Upper Missouri especially the Yellowstone, Belle Fourche, and Little Missouri tributaries, will be affected by developments in Montana, Wyoming, and North Dakota. Upper Colorado tributaries, especially those in the San Juan system, will be affected by developments in Colorado, Utah, and New Mexico. Although these will be the surface waters most affected, withdrawals from these streams will have downstream effects.

Although the Upper Colorado apparently has less groundwater available than does the Upper Missouri, numerous aquifers in alluvial deposits along rivers and streams may provide a potential water source for energy development in both basins. The Madison aquifer and several shallow aquifers in the Fort Union Coal Formation (Wyoming, Montana, North Dakota) are the most likely sources of groundwater for conversion facilities in the UMRB. The possibility exists for some of these groundwater sources to be mined if the water is used for conversion facilities or coal slurry pipelines.

B. Water Availability Impacts

The impact analyses reported in our Energy From the West progress and impact analysis reports[1] were designed to identify the potential impacts of energy resource development on water availability in the eight-state study area. These analyses attempted to identify two kinds of factors, technological and locational, which will largely determine the seriousness and

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[1] White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

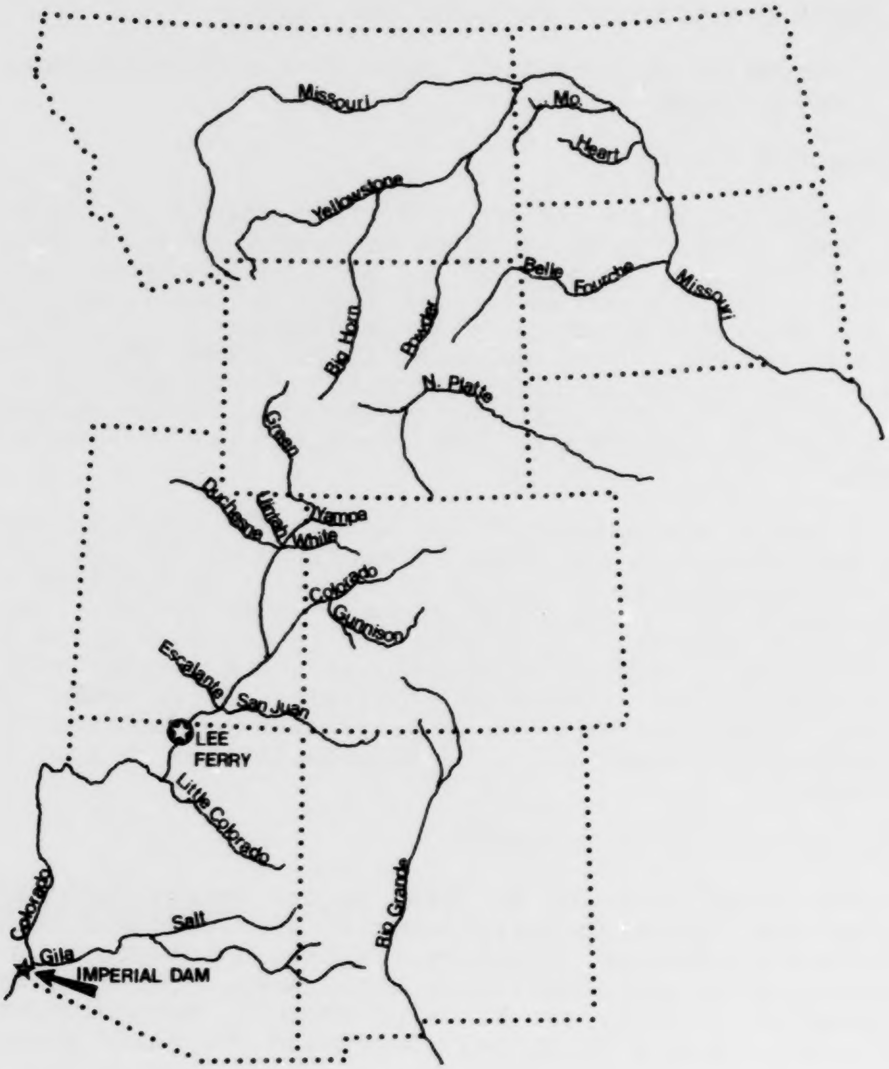
Missouri
Mo.
Heart
Yellowstone
Belle Fourche
Missouri
Big Horn
Powder
N. Platte
Green
Duchesne
Uintah
Yampa
White
Colorado
Gunnison
Escalante
San Juan
LEE FERRY
Little Colorado
Colorado
Salt
Gila
IMPERIAL DAM
Rio Grande

FIGURE 4-1: MAJOR SURFACE WATERS IMPACTED BY WESTERN ENERGY RESOURCE DEVELOPMENT

magnitude of the water availability problems actually likely to occur when development takes place. We found that the water requirements and labor intensity of development technologies and the type of mining used are the most critical technological factors; and that water availability, climatic conditions, and the coal characteristics (heat content and moisture, ash and sulfur contents) are the most important locational factors. This section summarizes the results of our water availability impact analyses and identifies the problems and issues which are likely to arise as a consequence of these impacts.

(1) Water Requirements

As shown in Figure 4-2, energy conversion facilities can vary considerably in terms of their water requirements. On an equivalent energy product basis, electric power generation requires more water than either of the synthetic fuel technologies considered and more than slurry pipelines. This is true whether the energy product is valued as thermal energy or as electrical energy. However, it should be noted that thermal and electric outputs cannot be compared directly and thermal and electrical energies have different economic values. Based on the best available data, high Btu coal gasification consumes more water than coal liquefaction but less than that for oil shale conversion by TOSCO II surface retorting.

Process water requirements are generally much smaller than are requirements for cooling.[1] The single exception is TOSCO II, the most water-intensive of the surface oil shale retorting processes currently being developed.[2] When wet cooling is used, cooling water requirements account for 53 to 96 percent of the

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[1] Water requirements for holding ponds are even less, representing about 1 to 3 percent of total water requirements for power plants and about 3 to 8 percent of total requirements for synthetic coal facilities.

[2] See White, Irvin L., et al. Energy From the West: Energy Resource Development Systems Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

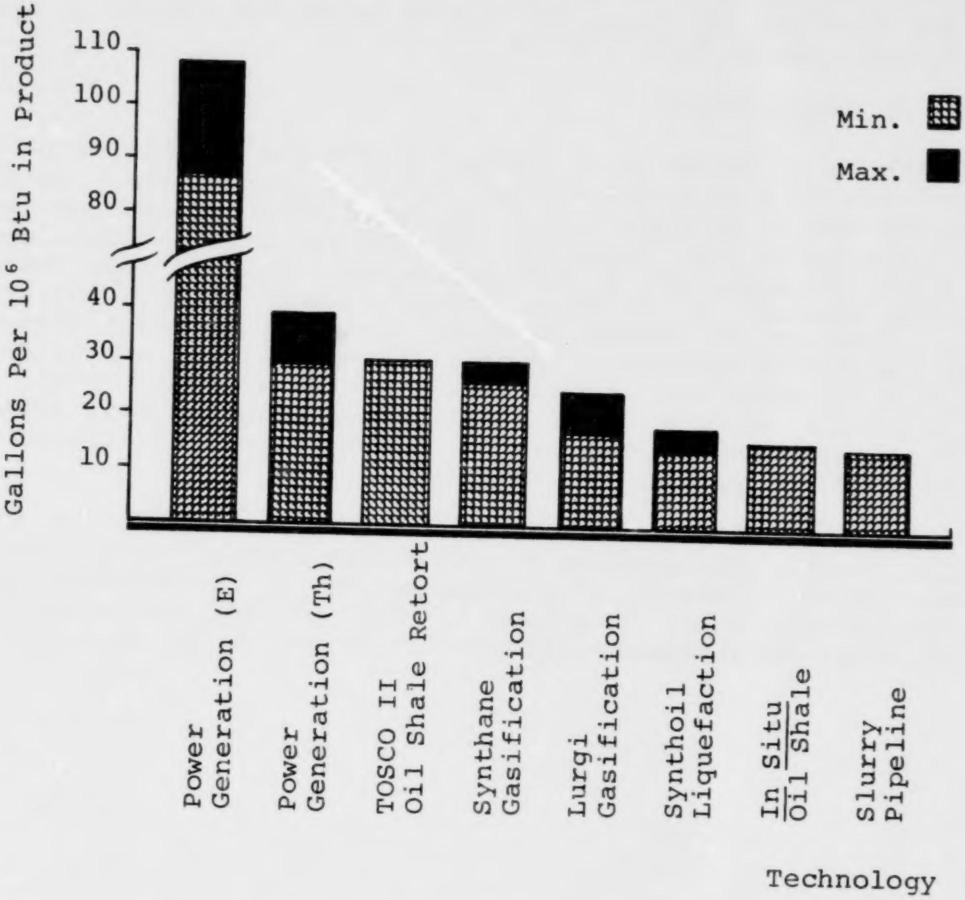

FIGURE 4-2: WATER REQUIREMENTS FOR ENERGY CONVERSION TECHNOLOGIES

Btu = British thermal unit
E = electric
Th = thermal

total water requirements for electric power plants and synthetic fuel facilities.[1]

Location can also affect water consumption, primarily because of the difference in the coal characteristics and the climatic conditions. For example, water requirements for a Lurgi facility in the Four Corners area can be about twice that required for the same facility in the Northern Great Plains. This is because of the low moisture content of the coal in New Mexico, the fact that the Lurgi process accepts wet coal, the high ash New Mexico coal requiring more water for disposal, and the need for supplemental irrigation to reclaim the land.[2]

Water requirements for mining and for energy related population increases represent at most ten percent of the water required for conversion facilities. However, these demands may still lead to water problems, especially if treatment and distribution systems are required to supply the water. Water requirements for most small communities are obtained from groundwater. In conjunction with withdrawals for mine dewatering and agricultural purposes, aquifer depletion is a potential problem.

Our estimates of the annual water requirements for energy resource development in the eight-state study area by the year 2000 are 1.4 million acre-feet per year (acre-ft/yr) for a Low Demand case (124 quadrillion British thermal units [Btu's] [124 Q's]) and 2.3 million acre-ft/yr for a Nominal Demand case (155 Q's);[3] this estimate calls for 350,000 to 1,117,000 acre-ft/yr to be used in the Upper Colorado and 990,000 to 1,225,000 acre-ft/yr in the Upper Missouri.

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[1] See White, Irvin L., et al. Energy From the West: Energy Resource Development Systems Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming. Water requirements can be decreased considerably by using some combination of wet and dry cooling, dry cooling, and by incorporating process design change. See Gold, Harris, et al. Water Requirements for Steam-Electric Power Generation and Synthetic Fuel Plants in the Western United States. Washington, D.C.: U.S., Environmental Protection Agency, 1977. See also Section 4.3 below.

[2] See White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[3] This mostly assumes a high degree of wet cooling, the choice developers are most likely to make at the present time, given economic considerations and current water management practices.

(2) Water Availability

Water availability estimates vary widely, especially for the Colorado River. Under the provisions of the 1922 Colorado River Compact,[1] Upper Basin states guarantee Lower Basin states 75 million acre-ft/yr over each consecutive ten year period or an average of 7.5 million acre-ft/yr. In the Mexican Water Treaty of 1944, the U.S. agreed to guarantee Mexico 1.5 million acre-ft/yr.[2] Assuming that the Upper Basin states are responsible for supplying half this amount (which they apparently do not assume), on the average, 8.25 million acre-feet must flow into the Lower Basin each year.[3]

Three of the most frequently cited annual virgin flow estimates for the Colorado are shown in Figure 4-3. If it is assumed that 8.25 million acre-feet will be delivered to the Lower Basin each year, on the average an estimated 5.25 to 7.95 million acre-feet would be available to the Upper Basin.

These estimates are based on average flows, around which considerable variation occurs from year to year. For example, Stockton and Jacoby estimate the average yearly virgin flow at 13.5 million acre-feet with a standard deviation of 3.4 million acre-feet. This means that in 67 percent of the years, flow would be between 10.1 and 16.9 million acre-feet. In drought years, flow could be much less. It now appears that 1977 will be the dryest year on record with a virgin flow at Lee Ferry estimated at 5.3 million acre-feet.[4]

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[1] Colorado River Compact of 1922, 42 Stat. 171, 45 Stat. 1064, declared effective by Presidential Proclamation, 46 Stat. 3000 (1928).

[2] Treaty between the United States of America and Mexico Respecting Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, February 3, 1944, 59 Stat. 1219 (1945), Treaty Series No. 994.

[3] Colorado Governor Richard D. Lamm maintains that Colorado and other Upper Basin states are not responsible for meeting the Mexican Treaty obligation.

[4] On these two points see, respectively: Stockton, Charles W., and Gordon C. Jacoby, Jr. Long-term Surface Water Supply and Streamflow Trends in the Upper Colorado River Basin, Lake Powell Research Project Bulletin Number 18. Los Angeles, Calif.: University of California, Institute of Geophysics and Planetary Physics, 1976; and Colorado River Basin Salinity Control Forum. Second Annual Progress Report: Water Quality Standards for Salinity in Colorado River System. Salt Lake City, Utah: Colorado River Basin Salinity Control Forum, January 1978, p. 3.

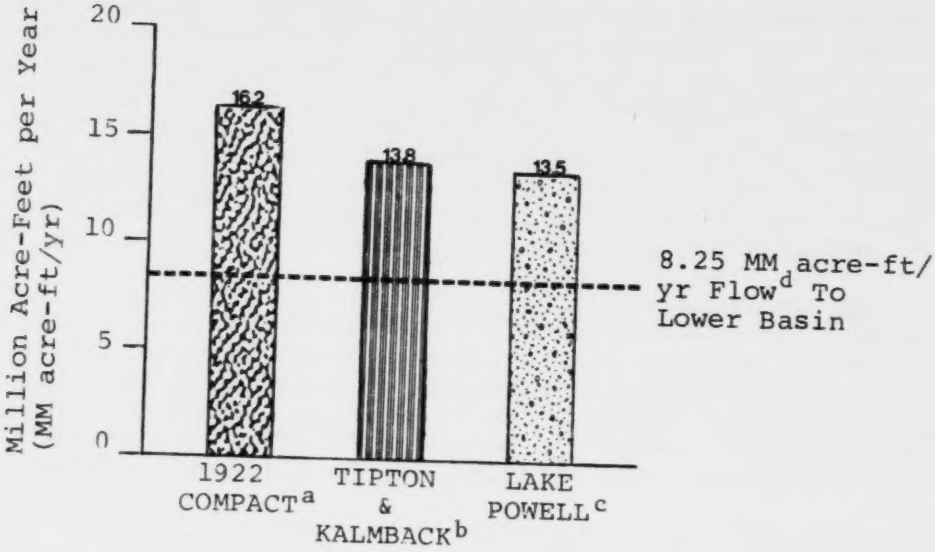

FIGURE 4-3: ESTIMATES OF AVERAGE FLOW IN COLORADO RIVER

[a] Colorado River Compact of 1922, 42 Stat. 171, 45 Stat. 1064 declared effective by Presidential Proclamation, 46 Stat. 3000 (1928).

[b] Tipton and Kalmbach, Inc. "Water Supplies of the Colorado River," in U.S., Congress, House of Representatives, Committee on Interior and Insular Affairs. Lower Colorado River Basin Project. Hearings before the Subcommittee in Irrigation and Reclamation, 89th Congress, 1st Session.

[c] Stockton, Charles W., and Gordon C. Jacoby, Jr. Long-term Surface Water Supply and Streamflow Trends in the Upper Colorado River Basin, Lake Powell Research Project Bulletin Number 18. Los Angeles, Calif.: University of California, Institute of Geophysics and Planetary Physics, 1976.

[d] This estimate assumes 7.5 million acre-feet to meet the obligation of the 1922 Compact and .75 million acre-feet to fulfill the Upper Basin's Share of the Mexican Water Treaty.

Current consumption in the Upper Basin is estimated to be 3.2 million to 3.7 million acre-ft/yr.[1] The projected increase for nonenergy users is 1.5 million to 1.6 million acre-ft/yr by the year 2000.[2] As shown in Figure 4-4, if maximum estimates of current consumption and projected energy and nonenergy water requirements are combined, by the year 2000 water requirements in the Upper Colorado River could exceed the average flow estimate (13.5 million acre-feet) by over one million acre-ft/yr. If minimum estimates of requirements are used, a large percentage (approximately 95 percent) of supplies will be depleted. This will almost certainly intensify existing water conflicts and over-tax the capability of existing institutions for allocating water rights and dealing with water conflicts.

Water availability does not appear to be as much of a problem in the Upper Missouri as a whole since water not currently being used is well in excess of maximum anticipated requirements. However, in many cases, surface water would have to be transported relatively long distances. And there are ongoing conflicts over beneficial uses of some stream segments, and some stream segments are over allocated, for example, in the Yellowstone River.[3]

Groundwater is also available in both river basins and, in some cases, might be an alternative water source for energy development. However, relying on groundwater can also produce problems, particularly if it is mined (consumed faster than the aquifer from which it is being withdrawn is recharged) or affects surface stream flows. An estimated 115 million acre-feet is contained in aquifers in the UCRB at a depth of less than 100 feet.[4] They are recharged at a rate of 4 million acre-ft/yr. Substantially greater quantities are estimated to occur in deeper reservoirs.

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[1] U.S., Department of the Interior, Bureau of Reclamation. Westwide Study Report on Critical Water Problems Facing the Eleven Western States. Washington, D.C.: Government Printing Office, 1975.

[2] U.S., Department of the Interior, Water for Energy Management Team. Report on Water for Energy in the Upper Colorado River Basin. Denver, Colo.: Department of the Interior, 1974.

[3] See U.S., Department of the Interior, Bureau of Reclamation. Westwide Study Report on Critical Water Problems Facing the Eleven Western States. Washington, D.C.: Government Printing Office, 1975, pp. 298-303.

[4] Price, Don, and Ted Arnow. Summary Appraisals of the Nation's Ground-Water Resources--Upper Colorado Region, U.S. Geological Survey Professional Paper 813-C. Washington, D.C.: Government Printing Office, 1974.

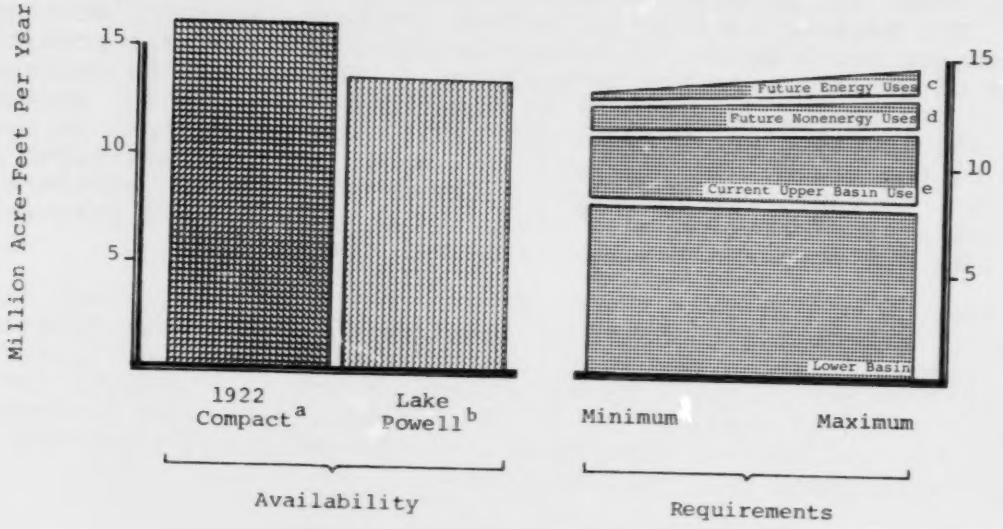

FIGURE 4-4: PROJECTIONS OF WATER REQUIREMENTS AND AVAILABILITY IN COLORADO RIVER, YEAR 2000

[a] Colorado River Compact of 1922, 42 Stat. 171, 45 Stat. 1064, declared effective by Presidential Proclamation, 46 Stat. 3000 (1928).

[b] Stockton, Charles W., and Gordon C. Jacoby, Jr. Long-term Surface Water Supply and Streamflow Trends in the Upper Colorado River Basin, Lake Powell Research Project Bulletin Number 18. Los Angeles, Calif.: University of California, Institute of Geophysics and Planetary Physics, 1976.

[c] This range represents the difference between the low demand and nominal demand scenarios. Refer to Chapter 3 of White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[d] U.S., Department of the Interior, Bureau of Reclamation. Westwide Study on Critical Water Problems Facing Eleven Western States. Washington, D.C.: Government Printing Office, 1975.

[e] U.S., Department of the Interior, Water for Energy Management Team. Report on Water for Energy in the Upper Colorado River Basin. Denver, Colo.: Water for Energy Management Team, 1974.

In the UMRB a total of 860 million acre-feet is estimated to be stored in the upper 1,000 feet of rock.[1] But most of these aquifers are not highly productive and will probably be used mainly to supply water for population growth associated with energy development. The Madison aquifer in northern Wyoming, southern Montana, and western North Dakota is currently being studied as a possible source of water for energy development.[2] The use of the Madison aquifer for energy development is limited by insufficient knowledge about its location and properties[3] and by its great depth in most areas of the basin. It is located at about a 7,500 foot depth at Colstrip, Montana, for example. Alluvial aquifers and aquifers in the Fort Union Formation also occur in the UMRB and are presently used only for municipal and agricultural needs.

The use of aquifers, especially in the UCRB, can affect flow in nearby streams which depend themselves on groundwater to maintain flows. This can result in conflicts with those having surface water rights. Until legal procedures are well defined for the resolution of conflicts over the interrelationships between groundwater and surface water flow, the use of groundwater for energy development will be restricted.

4.2.2 The Context of Water Availability Issues

The national and regional social and political contexts of western energy resource development were described generally in Chapters 1 and 2. This section focuses more specifically on the relevant western context within which the water availability impacts described above will occur. Following a general description of the historical development of water availability, the development of policies in three major areas of water availability policy are discussed: water rights and beneficial uses, conservation, and the roles and responsibilities of participants in the water policy system.

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[1] Missouri Basin Inter-Agency Committee. The Missouri River Basin Comprehensive Framework Study, 7 vols. Denver, Colo.: U.S., Department of the Interior, Bureau of Land Management, 1971.

[2] U.S., Department of the Interior, Geological Survey. Plan of Study of the Hydrology of the Madison Limestone and Associated Rocks in Parts of Montana, Nebraska, North Dakota, South Dakota, and Wyoming. Open-File Report 75-631. Denver, Colo.: Geological Survey, 1975.

[3] Swenson, Frank A. Possible Development of Water from Madison Group and Associated Rock in Powder River Basin, Montana-Wyoming. Denver, Colo.: Northern Great Plains Resources Program, 1974.

A. Historical Development

Because water has always been a vital but scarce resource in the West, the history of legal and physical controls is both complex and lengthy. Such controls have promoted two primary interests. The first is geographic equity; that is, diversions, impoundments, legal doctrines, and interstate compacts were needed to protect downstream users within a state and to provide at least minimal water supplies to states of the Colorado and Missouri River systems. The second is the economic interests of irrigated agriculture, a basic industry in each of the states which often depends on water supplies from distant sources.[1] Only relatively recently have water supplies for these interests been seriously challenged by other interests, such as energy resource development, environmental values for conservation, scenic beauty and natural habitats, Indian water needs, and increased municipal needs among others.

Although primarily serving agricultural interests, reservoir development for irrigation water and hydroelectric power have played an important part in the settlement of the West by increasing supplies to municipal users and in the utilization of other valuable resources, such as recreational uses of reservoirs. Physical controls also brought the federal government into western water policy at an early stage. The Reclamation Acts of 1902 and 1939 gave the Bureau of Reclamation (BuRec) a general mandate to make arid lands available for agricultural development and provide for construction of works to improve and divert water for irrigation, power generation, and other uses. BuRec has been largely responsible for the development of major western impoundments (such as Hoover, Glen Canyon, Flaming Gorge, and Navajo Dams in the Colorado River Basin) and, thus, has ongoing management responsibility for waters of these impoundments. For example, BuRec's responsibilities include water resources planning, operating irrigation networks and drainage systems, and meeting obligations of interstate compacts and private contracts. A critical element of these management responsibilities is to establish prices for the sale of waters from federal projects. As will be discussed below, these projects and federal pricing policies which reflect national goals have subsidized agricultural users of water by selling water well below the actual cost of providing it.[1] However, most of the West's water resources have been developed privately and approximately 75 percent of all irrigated agricultural usage in the eight-state study area is based on either private or nonfederal development.[2]

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[1] Irrigation generally accounts for 80 to 85 percent of total consumptive use in the West. See Glenn, Bruce, and Kenneth O. Kaufman. "Institutional Constraints on Water Allocation." Paper presented at the Energy, Environment, and Wild Rivers in Water Resource Management Conference, Moscow, Idaho, July 6-8, 1977.

The legal and institutional mechanisms for allocating and regulating this scarce resource also have a long history and are well established. As shown in Table 4-1, both the Colorado and the Missouri Rivers are subject to several intergovernmental agreements. One of the most important of these is the Colorado River Compact referred to earlier.[3]

The legal and institutional framework of western water policy is complicated by federal and Indian reserved water rights. Reserved rights recognize that when the U.S. establishes a federal reservation such as a national park, military installation, or Indian reservation, a sufficient quantity of unappropriated water is reserved to accomplish the purposes for which land was reserved. The reservation doctrine has been affirmed in the courts to hold that federal reserved rights are not subject to state appropriation laws and that federal water rights are not lost if they are not used.[4] These doctrines are significant because the federal government owns large percentages of western lands, for example about 70 percent of the land in the Colorado River Basin, and because Indians have claimed rights to as much water as is needed in many segments of the Colorado. This issue is elaborated in Section 4.2.2.B below.

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[1] For a comprehensive overview of the traditional federal role in water resource management, see Ingram, Helen, and J.R. McCain. "Federal Water Resources Management: The Administrative Setting." Public Administration Review, Vol. 37 (September/ October 1977), pp. 448-55.

[2] National Water Commission. Water Policies for the Future, Final Report. Washington, D.C.: Government Printing Office, June 1973, p. 127.

[3] Colorado River Compact of 1922, 42 Stat. 171, 45 Stat. 1064, declared effective by Presidential Proclamation, 46 Stat. 3000 (1928).

[4] Specific extensions of the reservation doctrine are the product of over fifty years of refinement of the Winters ruling (Winters v. U.S., 207 U.S. 564 [1908]). This doctrine also has been confirmed in Arizona v. California, 373 U.S. 546 (1963), Decree 373 U.S. 340 (1964).

TABLE 4-1: INTERSTATE COMPACTS AND AGREEMENTS

COMPACT OR AGREEMENT	LOWER COLORADO RIVER BASIN			UPPER COLORADO RIVER BASIN				UPPER MISSOURI RIVER BASIN		
	ARIZONA	CALIFORNIA	NEVADA	COLORADO	NEW MEXICO	UTAH	WYOMING[a]	MONTANA	NORTH DAKOTA	SOUTH DAKOTA
Colorado River Compact, 1922	Guarantees 7.5 MM acre-ft/yr to the Lower Basin									
Boulder Canyon Project Act, 1928, and Arizona versus California, 1963[b]	2.8 MM acre-ft/yr	4.4 MM acre-ft/yr	0.3 MM acre-ft/yr							
Upper Colorado River Basin Compact, 1948	50,000 acre-ft/yr			51.75% of flow remaining after Lower Basin and Arizona	11.25% of remainder	23% of remainder	14% of remainder			
Yellowstone Compact, 1950[c]										
Clark's Fork River							60%	40%		
Big Horn River							80%	20%		
Tongue River							40%	60%		
Powder River							42%	58%		
Belle Fourche River Compact, 1944[d]							10%			90%

MM acre-ft/yr = million acre-feet per year

acre-ft/yr = acre-feet per year

Sources: Colorado River Compact of 1922, 42 Stat. 171, 45 Stat. 1064, declared effective by Presidential Proclamation, 46 Stat. 3000 (1928); Boulder Canyon Project Act, Pub. L. 70-642, 45 Stat 1057 (1928); Arizona v. California, 373 U.S. 546 (1963), Decree 376 U.S. 340 (1964); Upper Colorado River Basin Compact of 1948, Pub. L. 81-37, 63 Stat. 31 (1949); Yellowstone River Compact of 1950, 65 Stat. 663 (1951); Belle Fourche River Compact of 1943, 58 Stat. 94 (1944).

[a] Surface waters in Wyoming are part of both the Upper Colorado River Basin and the Upper Missouri River Basin.

[b] Note: In Arizona v. California, the U.S. Supreme Court held that the compact-apportioned water available to the Lower Basin states was divided among them as follows: California, 4.4 MM acre-ft/yr; Arizona, 2.8 MM acre-ft/yr; and Nevada, 0.3 MM acre-ft/yr. Although the division was not agreed to by the states, the terms of the division were finalized by the Supreme Court's decree.

[c] The compact recognized existing appropriations for beneficial uses and divided the remaining waters as shown.

[d] Recognizes existing water right priorities of South Dakota and Wyoming. Remaining unappropriated water allocated as shown.

State appropriation systems are also critical elements in the development of western water policy.[1] The appropriation system establishes priority rights which grant a continuing right to the first user of water.[2] A second user, whether upstream or downstream, is only entitled to whatever water remains after the first user has met his needs. Hence, in drought years or in areas of limited supplies, secondary users may be denied water.

An appropriation right is generally quantified and sustained only by actual and continuous beneficial use. Although "beneficial use" is defined differently by different states,[3] it is a critical element of traditional water policy which has required withdrawal from the stream for the use to be beneficial. Within the past several years this traditional definition has been challenged by environmental interests who, in some cases, have successfully redefined beneficial to include instream values, such as recreation and protection of aquatic habitat. This conflict is discussed further in the following section.

B. Water Rights and Beneficial Use

Many water-use conflicts concern questions of water rights and beneficial use. As demands for water have increased, traditional interests such as irrigated agriculture have come into conflict with more recent interests such as energy industry and environmental interests. Questions over water rights and beneficial use also involve intergovernmental conflicts; most notably between Indian tribes and state governments, but also among intrastate agencies, among states, and between the federal government and states.

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[1] All eight states in the study area operate under appropriation systems, although North and South Dakota have only recently (1955) changed and still retain riparian systems for landowners exercising rights under that system prior to 1955. The riparian system holds that owners of land contiguous to surface water shall all have an equal right to "reasonable" use of that water which is not lost by nonuse.

[2] Water rights are obtained by application to a state engineer, other right administrator, or state water court for an appropriation or a change of an existing right. If the right is granted, the permit records the data, quantity, and use of water.

[3] Typical definition is "the amount of water that is reasonable and appropriate under reasonably efficient practices to accomplish without waste the purpose for which the water appropriation is lawful." See Colorado Revised Statutes, § 37-92-103 (4) (1963).

As suggested above, important questions and conflicts concerning beneficial use are being raised in the context of state water law. Although a variety of requirements on western water use have developed within each of the states,[1] probably the most important evolution in state water law has been the expansion of uses which are considered "beneficial." Several recent modifications have been made in definitions of beneficial use "for the public interests." Wyoming, for example, has added new criteria for evaluating water transfers which include economic loss to the community and the state and whether other water sources are available for the new use.[2] Of course, different states define public interest in different ways. As defined in Utah, the public interest appears to favor insuring a water supply for the development of the Uinta Basin. The Utah Water Code was revised in 1976 to allow the state engineer to approve applications to appropriate water for industrial, power, mining, or manufacturing purposes for specified time periods, after which the water will revert to the state for reallocation.[3]

However, many western states recently have taken action to recognize a public interest in the environment, such as instream water use,[4] preserving minimum flows, or authorizing appropriations to protect instream values.[5] In 1975, Montana responded to the uncertainties concerning the availability of water resources and increased conflicts over water rights by imposing a three-year moratorium on new appropriations from the Yellowstone River and calling for a thorough study to be made (see box "Yellowstone River Oversubscribed"). State legislation has been supplemented by environmental interest groups whose activities include suits to preserve scenic beauty, natural habitat, and recreational uses. For example, the Colorado Water Conservation Board, representing the Colorado Division of Wildlife, is currently suing the Colorado River Conservation District, which represents water rights holders. The issue is the preservation of minimum stream flows in the Crystal River, near Carbondale, Colorado, in order to protect the natural environment, including insuring enough water for trout.[1] This issue is a classic confrontation between environmental, agricultural, and commercial power interests. It also is indicative of the challenges being faced in many streams of the West which, like the Crystal River, are already over allocated. On the other hand, the uncertainties inherent in the evolving regulatory system may become too great a risk for some potential users of large quantities of water such as capital-intensive energy industries (see box "Project Threatened").

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[1] For example, consumptive use laws may require return flows, limit the timing of return flows, or specify the purposes of a withdrawal. For a discussion of some of the more well-established doctrines of the appropriation system, see White, Michael D. "Problems Under State Water Laws: Changes in Existing Water Rights." Natural Resources Lawyer, Vol. 8, No. 2 (1975), pp. 359-76.

[2] Wyoming Statutes § 41.4.1.

[3] Chapter 23, Laws of Utah, 1976.

[4] Traditional appropriation law generally held that instream uses, such as scenic beauty, were not beneficial. See Empire Water and Power Company v. Cascade Town Company, 205 Fed. 123 (8th Cir. 1963).

[5] See National Water Commission. Legal Protection of Instream Water Values. Springfield, Va.: National Technical Information Services, 1971.

YELLOWSTONE RIVER
OVERSUBSCRIBED

Requests for water from the Yellowstone River far exceed supplies, leading to a three year moratorium (1975-1978) on any new water rights. Demands on Yellowstone water include 8.8 million acre-feet by coal related industrial users, 6.6 million acre-feet by the State Health Department, and 8.2 million acre-feet by the State Fish and Game Commission. Agricultural interests have asked for more than is in the river.

--Coal Week, September 12, 1977; and Montana Department of Natural Resources and Conservation. Final Environmental Impact Statement for Water Reservation Applications in the Yellowstone River Basin. Helena, Mont.: Water Resources Division, State of Montana, 1975.

Environmental values articulated in the Wild and Scenic Rivers Act also have made new demands on already scarce resources. In the eight-state study area, portions of twelve rivers in the Colorado Basin are being considered for inclusion in the wild and scenic rivers system. Those most likely to affect energy development are the Escalante, White, Green, and the Colorado mainstream between the confluence with the Gunnison and the confluence with the Dolores.[2] The significance of the act is that it may be used to preserve minimum stream flows in order to protect instream uses. This could affect the water available for energy development and other uses and prevent impoundments or any water resources project which alters the nature of flow of a wild or scenic river. However, state water administrators generally do not believe that this act will reduce water available for appropriation.

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[1] Saile, Bob. "Minimum Stream Flows Sought." Denver Post, January 20, 1977.

[2] The National Park Serivce has suggested that further water withdrawal in the Escalante River will create dangerous flow levels, affecting habitat and species composition. Reynolds, Temple A. Personal communication, April 28, 1978.

PROJECT THREATENED

The proposed Juniper Cross Mountain Project, which would store up to 1 million acre-feet of water in reserviors on the Yampa and Little Snake rivers near Craig, Colorado, may be blocked by an endangered species, the squaw fish. Because the Yampa has been identified as a prime habitat of the squaw fish, a construction permit will not be given until the potential danger to the fish is determined.

--"Colorado Water Project Endangered by Fish." Denver Post, April 20, 1978.

The question of coal slurry pipelines has also provoked conflict among a variety of interests. A proposed slurry pipeline from Walsenburg, Colorado to Texas would carry 15 million tons of Colorado and Wyoming coal per year and use about 10,000 acre-feet of water per year. However, Colorado farmers, ranchers, legislators, environmental interests, and railroad interests are opposing the development of this line by Houston Natural Gas Company and Rio Grande Industries Corporation of Colorado.[1] Railroad interests, who say they currently operate at 30 percent capacity, have aligned with environmental interests to prevent the energy companies from acquiring eminent domain rights.[2]

Water requirements for this slurry pipeline also concern Colorado legislators, some of whom have proposed legislation which would allow the line to run through the state but would prohibit the use of Colorado water for exportation.[3] This would produce $2 million to $3 million in taxes for Colorado. The issue is also being addressed in the courts, where the pipeline company must prove that their plan to pump underground water will not injure water supplies for present users. The possibility of reduced water tables coupled with the fact that the pipeline companies have already purchased water rights from some area farmers has infuriated other farmers.[4]

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[1] Davidson, Craig. "Mesita Battleground For Water Dispute." Denver Post, December 19, 1977.

[2] Elaboration of these conflicts can be found in Chapter 11, "Transportation Analysis."

[3] A temporary prohibition on the export of water was passed by the legislature in 1977, but it is being reconsidered in the current session. See "It's Coal Slurry Pipeline Water That Worries Lawmakers." Wyoming State Tribune, December 20, 1977.

[4] Strain, Peggy. "Water, Land, Life - It's All One In Valley Pipeline Debate." Denver Post, November 13, 1977.

Because of the potentially large quantity of water at stake, one of the most important water right conflicts is the quantification of Indian reserved rights. Under the reservation doctrine, some Indian tribes have claimed rights to large quantities of water, threatening supplies to many current users with appropriated rights. These conflicts generally occur between Indian tribes and state governments. Indian tribes defending or claiming water rights usually have to do so originally in state courts.[1] Many Indians believe state courts are inherently more sympathetic to state interests. They also observe that federal courts are not generally inclined to review findings of fact from lower courts,[2] and conclude that the system is biased against them.

As shown in Figure 4-5, Indian tribes potentially control large quantities of western surface waters, many of which are prime sources of water for energy development. If Indians are ultimately found to hold prior and paramount rights, existing allocations and appropriations among and within western states could be seriously affected. In one case, the Supreme Court has held that Indian water rights were included in interstate compacts.[3] If this interpretation is applied generally, states would have to absorb any changes resulting from the quantification of Indian water rights. However, since Indians already exercise some of their water rights, primarily for agricultural uses, quantification may not be so large as to create a separate problem.

Federal reserved rights may be as important as Indian reserved rights because the amounts of water necessary to fulfill the purposes for which reservations were created have not been quantified. Lack of quantification is a problem because it leaves other water users uncertain as to how much water remains to fulfill their rights. This uncertainty is especially high with regard to state water laws. Moreover, the legal system developed to deal with federal and state water rights grants

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[1] This is based on the McCarren Amendment, as affirmed in U.S. v. District Court in and for County of Eagle, 401 U.S. 520 (1971); and U.S. v. District Court in and for Water Division No. 5, 401 U.S. 527 (1971).

[2] For example, state findings concerning questions such as "practicably irrigable acreage" could be combined with acceptable legal principles to minimize water available to tribes. Refer to MacMeekin, Daniel H. The Navajo Tribe's Water Rights in the Colorado River Basin. Unpublished report, May 1971.

[3] Arizona v. California, 373 U.S. 546 (1963), Decree 376 U.S. 340 (1964).

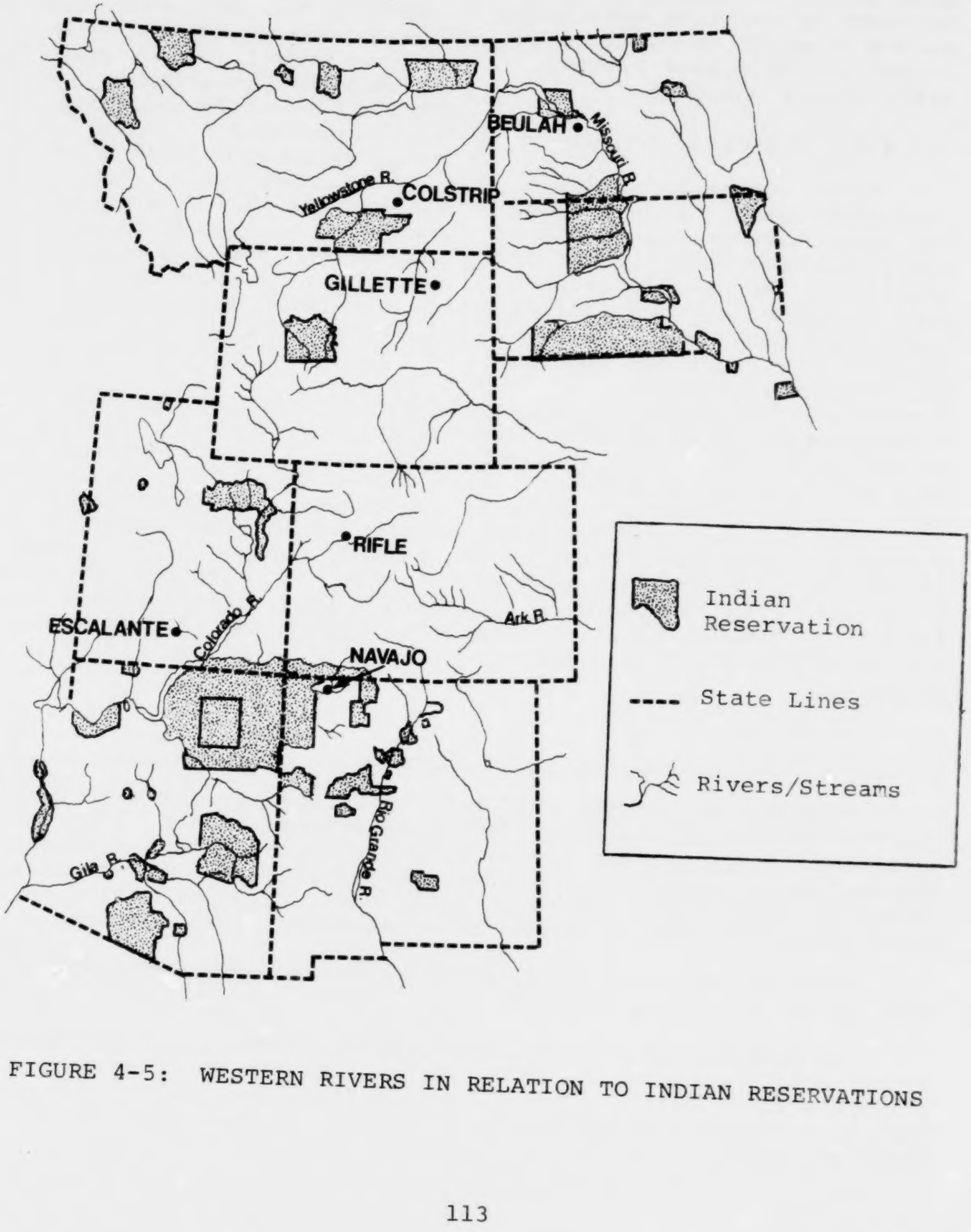
BEULAH
Missouri R.
Yellowstone R.
COLSTRIP
GILLETTE
RIFLE
Ark R.
ESCALANTE
Colorado R.
NAVAJO
Rio Grande R.
Gila R.
Indian Reservation
State Lines
Rivers/Streams

FIGURE 4-5: WESTERN RIVERS IN RELATION TO INDIAN RESERVATIONS

state and federal courts concurrent jurisdiction.[1] Determination of federal rights in state courts and vice versa adds to the complexities of problems by creating additional arenas in which quantification issues are addressed but not definitively resolved.

C. Water Conservation

Water conservation has become more important as demands for water have increased and as conflicts over water rights and beneficial use have increased. Most of the values and interests identified above also get expressed over questions about the efficient use of water. Further, water conservation threatens existing institutional mechanisms, especially state appropriation systems and federal pricing policies. This threat probably has been most visible regarding the Carter Administration's proposals for a new federal water policy. President Carter's environmental message of spring, 1977 (see box) and proposals by the Water Resources Council suggested that the Administration was pushing for powers to impose federal regulation on western water use.[2] At least part of these proposals were based on specific charges that western states have failed to conserve water, to integrate ground and surface water conservation, and to provide minimum stream flows for fish and wildlife.[3]

CARTER ADMINISTRATION POLICY

A major aspect of the President's Environmental message to Congress in May, 1977 was the need for comprehensive reform of water resources policy. Carter's message emphasized conservation, going well beyond the much publicized recommendation to cancel fifteen public works projects and to redesign many others. The Administration has also proposed legislation to reduce by 30 percent the funds available to municipalities to construct sewage plants if cities do not conserve 15 percent of current water usage.

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[1] Although the courts have held that federal reserved rights are not subject to state appropriation systems (see p. 4-9), the jurisdiction for hearing Indian claims to water rights depends on the particular situation. In some cases, Indians must originally defend or claim water rights in state courts (see p. 4-12), in other state and federal courts have concurrent jurisdiction.

[2] Federal and state conflicts over water policy are elaborated in the following section.

[3] As reported in "Washington Could Wreck Western Water Policy." Denver Post, December 17, 1977. Details of the Water Resources Council's Water Policy Proposal can be found in: Water Resources Council. "Water Resources Policy Study." 42 Fed. Reg. 36,787-95 (July 15, 1977).

Charges of wasteful and inefficient water use are directly tied to state appropriation systems, which are often blamed for discouraging conservation, and to federal subsidies in the form of dams and irrigation projects that make the price of water artificially low.[1] Aspects of appropriation systems such as consumptive use and nonimpairment doctrines[2] can create disincentives to conserve by specifying exact purposes of use. For example, there may be no incentive to minimize water used for another purpose, thereby requiring any excess water to be returned to the stream.[3]

If a user has been diverting only a portion of his total water right for several years, it is not likely that he would be able to begin diverting all of his potential allocation if downstream users had become dependent on the return flow. This aspect of the appropriation system, sometimes referred to as "historical use," creates an incentive for users to "use or lose" all of their water rights. Some attempts to compensate for the use of another user's right have also been rejected. As waters of the Colorado have become overappropriated, some users have tried to devise means such as using water transferred from another basin for compensatory water rights that might be injured by any change. One recent attempt to create compensatory water rights was to remove water-consuming phreatophytes from stream banks.[4] This attempt was struck down by the Colorado Supreme Court as being fundamentally different than using transferred water for compensation.[1]

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[1] In general, the percentage of construction costs repaid by irrigated agriculture has decreased over the years. In some cases, water users pay about 10 percent of construction costs. See Mann, Dean E. "Water Planning in the Colorado River Basin States." Paper presented at the Annual Meeting of the Western Political Science Association, March 16-18, 1978, Los Angeles, California.

[2] Impairment doctrines and laws are elaborated in White, Michael D. "Problems Under State Water Laws: Changes in Existing Water Rights." Natural Resources Lawyer, Vol. 8, No. 2 (1975), pp. 359-76.

[3] For example, in some states, irrigation farmers apparently did not gain the right to use the water saved by improved irrigation methods. See, for example, Salt River Valley Water Users' Association v. Kovacovich, 411 F. 2d 201 (1966), 3 Arizona app. 28; and Southeastern Colorado Water Conservancy District v. Shelton Farms, Inc., 529 P. 2d 1321 (Colo. 1975).

[4] Phreatophytes are riparian vegetation plants which obtain water from the water table or from the soil just above it.

Since BuRec operates within state water law, BuRec contracts for water from federal reservoirs also operate under a "use or lose" policy. The incentive is for right holders, primarily farmers and ranchers, to use maximum allocations rather than to conserve water.[2] Secondly, BuRec's "ability to pay" pricing policy makes supplies available to many users substantially below costs. Environmental Defense Fund analysis of the Fruitland Mesa Project in western Colorado suggests that users of the project's water, primarily farmers, will return only $3.8 million of the total construction costs of $86 million.[3] Even though proponents of the project claimed that the remainder of the project's costs will be paid from hydroelectric power revenues, the policy does create a cheap resource for consumptive users.[4]

These policies seem characteristic of the Department of the Interior's (DOI) traditional approach to water management; that is, to maximize supply by means of large construction projects and subsidize some water users such as agriculture. This approach has come under increasing criticism as demands for Colorado River water have increased and as more environmental protection agencies have been established in government. Secretary of the Interior, Cecil Andrus, has become one of the more important critics of the traditional water management system.[5] In a recent letter to President Carter, Andrus charged that:

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[1] Southeastern Colorado Water Conservancy District v. Shelton Farms, Inc., 529 P. 2d 1321 (Colo. 1975).

[2] Strabala, Bill. "Farmers Often Overuse Water, U.S. Agency Says." Denver Post, April 13, 1977.

[3] El-Ashry, Mohamed T., and Robert M. Weaver. "Colorado River Projects: Impacts and Alternatives." Denver Post, April 17, 1977. The Fruitland Mesa Project has been canceled by Congress on recommendation of the President.

[4] DOI data show that those benefiting from federal irrigation projects pay a nineteen percent share of the costs. As reported in "Broad Water Reforms Eyed." Denver Post, May 19, 1977.

[5] For an elaboration of intraagency disputes in the federal government regarding water policy, see Doerksen, Harvey. "Water Politics and Ideology: An Overview of Water Resources Management." Public Administration Review, Vol. 37 (September/October 1977), p. 446.

> Federal financing and an archaic water law system which rewards early development, no matter what the use, has been a disincentive to conservation. As a result, the per capita water consumption in many areas of the arid and semiarid West exceeds the national average.[1]

State governments in the West generally, and state water engineers in particular, usually disagree with these characterizations.[2] In spite of the incentives, many westerners argue that most farmers realize supplies are finite and use water judiciously. They argue that most of the low-cost water is in use, so that most farmers who do not receive water from a federal project must supplement it with other more costly sources, such as groundwater. Thus, any subsidized water that is wasted must be replaced by more costly water. Further, even though federal water is subsidized, it still represents a major expenditure to the farmer, who is not likely to want to pay for more than he needs. Finally, irrigation water charges from BuRec projects are often developed for acres irrigated rather than for acre-feet of water delivered, although some contracts include water conservation provisions--providing a base quantity of water for one price and charging higher prices for additional water.[3]

Agriculturists also argue that water is a renewable resource and essentially nondestructible; that is, a farmer cannot consumptively use more than plants on his farm consume; any excess runs off back into streams or percolates into groundwater systems. The only wastes involved are those associated with the growth of nonproductive vegetation and evaporation from wet and marshy areas. This argument is important to environmentalists, because many water resource people favor reducing waste from wetlands and nonproductive vegetation. Environmentalists usually argue that wetlands and nonproductive vegetation are valuable habitat for wildlife.

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[1] "Andrus Attacks 'Use or Lose' Water Policy." Denver Post, May 19, 1977.

[2] Fischer, Ward H. "Coloradans are Terrorized by Federal Water Policy Report." Denver Post, September 4, 1977; and "Washington Would Wreck Western Water Policy." Denver Post, December 17, 1977.

[3] Irrigation water costs can vary considerably, from a minimum of three to five dollars an acre (including operation and maintenance costs) in a region of low-value production such as feed grains up to a maximum of 25 to 30 dollars an acre in regions of high-value crops such as orchards. Hence, to quote average prices for water supplies can be very misleading. Kauffman, Kenneth O., U.S., Department of the Interior, Bureau of Reclamation, Denver, Colorado. Personal Communication, June 28, 1978.

Environmental and agricultural conflict over water conservation appears well-entrenched. The Environmental Defense Fund argues that quantities of water wasted are not trivial--from 30 to 100 percent.[1] They also argue that federal subsidies contribute to the production of water-intensive forage crops, such as alfalfa. Forage crops apparently account for about 60 percent of the land irrigated by BuRec's two largest projects in Arizona (Salt River and Gila projects).[2]

Environmental interests also include water quality and recreational uses. Excess diversions contribute to poorer water quality because irrigation return flows are the primary source of rising salt concentration, already a critical problem in the UCRB.[3] Environmental groups such as the Sierra Club also object to federal water projects because they prefer free-flowing rivers to be preserved for recreational uses and to preserve natural habitats.[4]

D. Intergovernmental Tensions

Conflicts over water rights, beneficial use, and water conservation have raised questions about the roles and responsibilities which various governmental units should play. As indicated in the above discussions, water policy issues involve many conflicts in intergovernmental relations. The most important of these conflicts with respect to western water policy appears to be the tension between individual state initiatives and pressures for a centralized federal water policy.

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[1] As reported by Gill, Douglas. "U.S. Projects Key to Future West Water Use." Denver Post, July 17, 1977. These estimates appear to be based on the inefficiencies of irrigation systems rather than how much water actually could be saved from consumptive use.

[2] As reported by Ognibene, Peter J. "Wasting the West's Water." Washington Post, June 5, 1977. The costs, risks, and benefits of crop switching are evaluated in Section 4.3.

[3] For example, estimated annual damages because of salinity will rise from about $53 million in 1973 to $124 million by 2000 unless additional control measures are applied. See Frederick, Kenneth D. "When the Colorado River Dries Up, What Will We Do?" Denver Post, July 17, 1977. Water quality is discussed in Chapter 5.

[4] Strain, Peggy. "Water Projects' Need Debated." Denver Post, February 1977.

As has been suggested, several western states have begun to take new initiatives in water policy, such as new legislation protecting diverse interests in water use and Montana's three-year moratorium on allocations in the Yellowstone River. Utah has taken a more radical approach by proposing a water management plan which could substantially alter its appropriation system. Although it has not been implemented, the plan would divide the state into hydrologic planning units which would be the basis for quantifying rights, record-keeping of existing water resources, and establishing the quantity of new water rights and transfers. The Utah plan is also designed to allow greater access for parties-at-interest to express their values about beneficial uses. State initiatives have also begun to affect other western states. For example, Colorado's temporary law prohibiting Colorado water in slurry pipelines could affect both the export of coal and energy development in Texas.

Increased state initiatives have contributed to changes in traditional relationships between states and DOI. Corresponding to an increased demand for states' rights (see box "States' Rights Stress"), DOI has begun to be more sensitive to the needs of individual states. In western Colorado, DOI favored energy development by granting contracts for water from federal reservoirs to oil shale companies. However, DOI also granted Colorado's Governor Lamm veto power over the sale of some irrigation water to energy industries if the Governor finds the sale inconsistent with state plans and programs.[1] In Montana, DOI made 300,000 acre-feet of water from the Fort Peck Reservoir available to the state for resale. The water will be available at the same minimum fee for which DOI has been leasing it to private industry.[2]

Demands for states' rights have been most evident in response to Carter Administration water policies which have repeatedly threatened the western states. These threats began with proposals to limit or stop funding several water-development projects, many of which were western. Citing a general need for wise management and conservation, President Carter identified specific western projects as being inefficient and damaging to water quality and the environment.[1] Although the President's recommendations have met with little success in Congress, they were only the beginning of troubles for the western states.[2] They were followed by a proposal to enforce a 1902 law limiting the amount of land a farmer is allowed to irrigate with water from federal reclamation projects to 160 acres. This proposal brought sharp reactions from western politicians in several public hearings. Wyoming Governor Ed Herschler, for example, said the proposal would "upset the entire western agriculture" and called for equivalency standards which would allow ranchers in arid regions to irrigate more land than those in humid areas.[3] The American Farm Bureau Federation filed suit in a Federal District Court in California to prevent implementation of the proposal on the ground that Secretary Andrus violated the National Environmental Policy Act by not preparing an environmental impact statement (EIS) before issuing new rules and regulations.

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[1] Strabala, Bill. "Lamm Gets Water Use Veto Power." Denver Post, February 1977.

[2] The water is to cost $20 per acre-foot. See Gill, Douglas. "Water May Be Auctioned Off." Denver Post, October 3, 1976.

STATE'S RIGHTS STRESSED

Colorado political bodies are stressing state's rights regarding energy, agriculture, and water policy. In a recent talk with President Carter, Coloradans delivered a common message that policies governing water distribution should be controlled by the states. Coloradans urged the President to view first-hand their difficulties with water and expressed strong skepticism of those who say "I'm from Washington and I'm here to help you."

--Strain, Peggy, and Gary Cook. "Panelists Stress State Water Rights." Denver Post, October 1977.

Probably most threatening to relationships between the federal government and the western states has been the Administration's proposals for a new national water policy. The proposals, developed by the Water Resources Council in July 1977, were originally scheduled to be formalized by the President by November

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[1] Larsen, Leonard. "Dams Ineffective, Too Costly, Carter Says." Denver Post, April 20, 1977.

[2] Of the 320 projects reviewed to see if they would receive federal funding, only nine projects were halted by Congress. Eight of these were in the West.

[3] "Limits on Irrigation Opposed in Wyoming." Denver Post, November 16, 1977. For an elaboration of the issues involved in proposals to enforce the 1902 acreage limit, see, Kirschten, J. Kicken. "The Quiet Before the Shootout Over 'The Water Law of the West.'" National Journal, Vol. 10 (January 28, 1978), pp. 149-53.

[4] "Farmers Ask Stay of New Irrigation Rules." Chicago Tribune, November 11, 1977.

1977. However, because of critical reaction at a series of public hearings in the West, the review period for the water policy package was extended to February 1978, and water policy legislation was not sent to Congress until June, 1978.[1]

Recommendations of the draft water policy proposal closely paralleled the conflicts outlined above: reforms to be investigated include more efficient irrigation practices, new water pricing strategies, better management of groundwater supplies, and water resource management that would protect the environment. According to Interior Secretary Andrus:

> The day of considering money to be the only solution to water problems is over. We want results not in the form of more dams and canals and the like, but in the form of more rational use of this very precious resource.[2]

Perhaps most upsetting to the western states were proposals for a comprehensive national water resources policy that would fundamentally change state water law. A formal response to the proposals, submitted on behalf of several Colorado water users associations and conservation districts, charged that the premise that state policies are inept and the conclusion that policies developed by the federal government for the West could be an improvement "surpasses credulity."[3] Further, even though Interior Secretary Andrus is a former western governor, Governor Lamm of Colorado suggested that "most or all of the governors were upset at the way the West was treated in the way of water policy."[4]

Although uncertainty still exists about how these relationships will unfold, President Carter stepped back from many of his original proposals in the revised national water policy announced on June 7, 1978. Although the plan retained proposals to encourage conservation programs and to require states to contribute front-end money for new water projects, it explicitly recognized state water management responsibility. In his announcement of the policy, President Carter said: "These water policy reforms will not preempt state or local water responsibilities."[1] Colorado Governor Lamm responded that "The West can definitely claim a limited victory."[2]

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[1] Further, a federal district judge ruled in March that a revised federal water policy cannot be submitted to Congress until an EIS has been developed. See "Judge Blocks Submission of Water Plan to Congress." Denver Post, March 11, 1978.

[2] Kirschten, J. Dicken. "Turning Back the Tides of Long-Time Federal Water Policy." National Journal, Vol. 9 (June 11, 1977), pp. 900-3.

[3] Fischer, Ward H. "Coloradans are Terrorized by Federal Water Policy Report." Denver Post, September 4, 1977.

[4] Parsons, Dana. "West Fears Federal Power Grab." Denver Post, September 3, 1977.

4.2.3 Summary

Energy resource development in the West can possibly be constrained by and will add to existing water availability problems and issues. Development will affect most of the surface waters in the eight-state area and particularly the Upper Colorado and Yellowstone River Basins. In fact, it is possible that water demands will substantially exceed available supplies in the UCRB by the year 2000. On a more localized basis, this has already occurred for specific stream segments. Hence, energy resource development will exacerbate conflicts among energy industry, agriculture, environment, government, and other water users.

These general conflicts raise the possibility for several specific problems and issues:

- Restricted energy development, particularly on-site conversion of energy resources, throughout the eight-state study area, and, therefore, loss of corresponding economic benefits;
- Environmental degradation, particularly loss to instream values of water, habitat damage from wetlands removal, and scenic and aesthetic values;
- Changes in the western economy, particularly if water for irrigated agriculture is converted to other uses;
- Restricted development of Indian lands and/or damage to Indian values and culture;
- Conflicts over political autonomy, authority, and responsibility among governmental units and between public and private sector participants.

The importance of water has always been appreciated in the West, but new and larger demands on existing resources have increased the visibility and significance of water policies. In addition to raising questions about the adequacy of resources and the distribution of limited supplies, this situation also raises questions about the adequacy of existing institutions to cope with new demands for resources and for access to policymaking processes. The courts have played a major policymaking role; yet they characteristically operate very slowly and create piecemeal, localized, and short-term resolutions to problems. While the judicial process and others have been successful in some senses, they may not remain viable as problems become region-wide and begin to influence national goals such as decreased dependence on insecure foreign energy sources.

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[1] As reported by Strain, Peggy, and Leonard Larsen. "Water Policy Victory for West." Denver Post, June 7, 1978.

[2] Ibid.

The fragmented nature of the existing regulatory system for water resources management also raises questions, particularly regarding the inadequacy of water resource and use data and resistance to institutional innovations. Hence, mechanisms for resolving water availability problems and issues associated with increased energy development will need to address these potential inadequacies by considering more comprehensive approaches to water resource management, by accommodating the participation of diverse interests and values, and by searching for ways to facilitate compromises before rather than after large scale impacts are felt.[1]

4.3 ALTERNATIVE POLICIES AND IMPLEMENTATION STRATEGIES

4.3.1 Introduction

As suggested in the discussion above, conflicts among water users will almost certainly increase as region-wide as well as localized water shortages become more likely. Policymakers can seek to achieve two kinds of policy objectives in dealing with water availability problems and issues: first, try to meet the expanded needs of water users; and, second, meet only a part of those needs.

As shown in Table 4-2, two general categories of alternatives can be used to attempt to achieve the objective of meeting the expanded needs of water users:

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[1] For a discussion of approaches to these institutional problems, see, Kaufman, Kris G., and Alice Shorett. "A Perspective on Public Involvement in Water Management Decision Making." Public Administration Review, Vol. 37 (September/October 1977), pp. 468-69; Fox, Irving K. "Institutions for Water Management in a Changing World." Natural Resources Journal, Vol. 16 (October 1976), pp. 743-58; and Sewell, W.R. Derrick. "The Changing Context of Water Resources Planning: The Next 25 Years." Natural Resources Journal, Vol. 15 (October 1976), pp. 791-805.

TABLE 4-2: WATER AVAILABILITY ALTERNATIVES

OBJECTIVE	GENERAL ALTERNATIVE	SPECIFIC ALTERNATIVE
Meet the Needs of Water Users	Increase water supply (augmentation)	Surface water diversion, transfer, and storage Interbasin Intrabasin Groundwater storage Groundwater use Weather modification Vegetation management Runoff modification Removal of nonproductive vegetation
	Increase use of existing supply (conservation)	Conservation for energy resource development Choice of technology Cooling and process designs Municipal wastewater for cooling Conservation for agriculture Irrigation efficiency improvements Crop selection Conservation for municipalities
Meet Only a Part of Total Water Needs	Limit or eliminate some uses	Limit or eliminate water-intensive agriculture Limit or eliminate water-intensive energy development

- Increase water supply (augmentation);
- Increase the use of existing supply (conservation).

Increasing water supply has been the traditional response to water availability problems in the West. This policy approach could be continued by adopting specific augmentation alternatives such as intrabasin diversions and transfers and increased storage in surface impoundments. Existing water supplies can also be augmented by other alternatives such as interbasin transfers, groundwater storage, weather modification, and controlling or managing vegetation. In order to meet expanded needs of water users, policymakers may also choose to improve the use of existing supplies through conservation in energy resource development, irrigated agriculture, municipal, and industrial uses.

Policymakers may take a much different approach by meeting only a part of future water needs. By choosing this objective, policymakers would be explicitly acknowledging that water supplies are inadequate and a need to allocate available supplies to those uses most valued in specific areas. As suggested in Table 4-2, this objective can be achieved by limiting or eliminating water intensive uses, including both energy resource development and irrigated agriculture.

In the remainder of this section, these policy alternatives are discussed in more detail. First, each category of alternatives is described and implementation strategies are identified (Section 4.3.2). This is followed by an evaluation and comparison of augmentation and conservation alternatives (Section 4.3.3 and 4.3.4).

4.3.2 Description of Alternatives

A. Increasing Water Supply (Augmentation)

Table 4-3 identifies seven specific alternatives for augmenting water supplies. For each alternative, implementation strategies and potential constraints are also identified. Several of these alternatives are capital-intensive, particularly those involving diversion, transfer, and storage. Thus, most of these alternatives will require a federal role, probably in the form of direct funding. However, states probably will be more involved than they have been in the past, especially if the recently proposed national water policy requiring states to "front-end" 10 percent of the construction costs of federal water projects is adopted and implemented. Although diversion, transfer, and storage represent the traditional response in the West, their use in the future will be constrained by questions about their economic and environmental costs. Interbasin transfers from the Columbia River to the Colorado River are currently prohibited by federal law.

TABLE 4-3: IMPLEMENTATION STRATEGIES FOR INCREASING WATER SUPPLY

SPECIFIC ALTERNATIVE	IMPLEMENTATION STRATEGY	CONSTRAINT
Surface Water Diversion, Transfer, and Storage		
Interbasin	Federal authorization and funding with state cost contributions	Current federal law prohibits interbasin transfers from Columbia to Colorado River Basin Modification of interstate compacts would probably be required Probable resistance from environmentalists
Intrabasin	Federal authorization and 10% state contributions	Considerable environmental opposition because of threats to scenic and wilderness areas Economic efficiency questionable Few acceptable locations remain on Colorado River
Groundwater Storage	Federal authorization and funding would be required Revision of legal definition of groundwater rights would be required in many states	Lack of political and administrative rewards for projects which are relatively invisible and provide no recreational opportunities Legal constraints regarding rights to groundwater, which often belong to private property owner
Groundwater Use	Federal or industry-sponsored incentives to improve technologies for mining deep aquifers Many shallow aquifers are accessible under current legal and technological conditions	Groundwater mining can affect surface stream flow Many states have legal limits to amount of groundwater which can be mined Considerable uncertainty about extent of groundwater resource, relationships of groundwater to surface water, and seepage problems
Weather Modification	State authorization and clarification of legal uncertainties regarding liability Federal subsidies for improving technology Federal resolution of interstate legal uncertainties	Legal constraints on liability Uncertainty about effectiveness and environmental costs
Vegetation Management		
Runoff modification	Cooperation between private landholders and public sector would be required	Environmental opposition due to potential damage to wilderness, forest areas, and wetlands
Remove nonproductive vegetation	Federal and state subsidies and management assistance	Uncertainty associated with lack of experience with actual applications

Groundwater development technologies, including both storage and withdrawal, are less capital-intensive but do require pumping and conveyance systems (pipelines or canals). However, capital costs for groundwater usage could increase substantially if policymakers choose to develop technologies for developing deep aquifers. As is true for several augmentation alternatives, groundwater development is constrained by considerable uncertainty. Inadequate information exists about the quantities of water available and economically accessible, the potential effect on surface water flow if groundwater is mined, and the reliability of aquifers for storage.

Environmental modification alternatives to augment water supplies include weather modification and vegetation management. Weather modification by cloud seeding could be used to increase precipitation either locally or region-wide.[1] Although weather modification technologies are still developing, experiments in Colorado, Utah, and New Mexico suggest that these technologies can produce detectable increases in snow accummulation and subsequent runoff.[2]

Vegetation management includes managing uplands to increase runoff and removing nonproductive vegetation (phreatophytes) from streams, stream beds, and along canals, irrigation ditches, and other man-made water courses to decrease losses to evapotranspiration. Upland vegetation management to increase runoff can be achieved by reducing density (of trees and shrubs, for example), converting to a cover type which uses less water, and trapping or transporting snow to reduce evaporation.

Phreatophytes, such as salt cedar and mesquite, draw significant quantities of water from groundwater and reduce stream flow and discharges from springs. Since phreatophytes occupy large areas of land in the West, removing them could be used as an augmentation alternative either locally or region-wide.

Both weather modification and vegetation management will involve risks, largely because there is so little experience in actually applying these techniques. Questions have also been raised about environmental damage from both alternatives, but particularly concerning the potential damage to wilderness, scenic, and forest areas if vegetation is removed, made less dense, or significantly changed.

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[1] In the Rocky Mountains weather modification is not likely to reduce precipitation "downwind," since most moisture on the Eastern side of the Rockies is derived from air moving up from the Gulf Coast. Weisbecker, Leo W. Technology Assessment of Winter Orographic Snowpack Augmentation. Norman, Okla.: University of Oklahoma press, 1975.

[2] National Academy of Sciences, National Research Council. Weather and Climate Modifications: Problems and Progress. Washington, D.C.: National Academy of Sciences, 1973, p. 80.

B. Increasing Use of Existing Supplies (Conservation)

Conservation alternatives are generally less well-developed and accepted than are options for increasing water supplies by augmentation. Specific conservation alternatives shown in Table 4-4 emphasize conservation for energy and agricultural uses, but include two options for municipal conservation. As shown previously in Section 4.2.1, projected water demands for energy resource development over the next 25 years are substantial--reaching as much as 1,200,000 acre-ft/yr by 2000. Since these are additional demands on an already water-scarce situation, water conservation for energy is likely to be a logical choice for increasing the use of existing supplies. Since water for cooling is the largest single water requirement for electric power plants and synthetic fuel facilities, conservation alternatives include less consumptive cooling technologies which combine wet and dry cooling technologies. Policymakers may also choose to site less water-intensive technologies in some location; for example, Lurgi requires less water than does Synthane gasification. There are also indications that water requirements for power plants may be reduced by using municipal water for cooling.[1]

Agricultural conservation is also a logical conservation choice since irrigated agriculture consumes 80 to 95 percent of the water currently consumed in our eight-state study area. Suggestions for conserving agricultural water often include improved irrigation technologies such as changing from flooding and furrow methods[2] to mechanical applications, such as sprinkler or trickle irrigation.[3] Water loses from agricultural diversions can be reduced by lining canals to prevent loss to groundwater and to transpiration by weeds. Although each of these specific alternatives may improve the efficiency of irrigation, this is not synonymous with conservation since much of the water withdrawn may be made available to another user. What we mean

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[1] Humphris, T.H. "The Use of Sewage Effluent as Power Station Cooling Water." Water Research, Vol. II, No. 2 (1977), pp. 217-22.

[2] That is, land is simply flooded surface-wide or along furrows with excess water draining off the land or soaking into the ground,

[3] Trickle systems generally use pipes, from which water drips into the soil through outlets near each plant to minimize evaporation, runoff, and percolation losses.

TABLE 4-4: IMPLEMENTATION STRATEGIES FOR INCREASING USE OF EXISTING SUPPLIES

SPECIFIC ALTERNATIVE	IMPLEMENTATION STRATEGY	CONSTRAINT
Conservation in Energy Resource Development	Encourage technologies which have lowest water requirements, such as Synthoil liquefaction Establish water ceilings on withdrawals for conversion facilities Require water-saving cooling technologies and the use of municipal wastewater for energy conversion facilities	Subsidies would be required in order for Synthoil to be a large-scale development option High economic costs associated with cooling technologies which save the most water Current political and regulatory systems constrain comprehensive policymaking
Conservation for Irrigated Agriculture	Federal subsidies would probably be required for farmers to afford capital costs of sprinkler or trickle irrigation systems Change state appropriation systems to create water rights for salvaged water Federal guarantees would be required for crop switching because of the high risk associated with vegetable crops	Current political institutions and economic infrastructure would make large-scale irrigation changes very difficult Uncertainty about success of most options if applied state- or region-wide
Conservation for Municipal Uses	Withhold federal grants under FWPCA for wastewater treatment unless 15% conservation is attained Increase federal subsidies for innovative water conservation technologies	Only feasible for 5 or 6 large municipalities in the West and municipal water quantities are trivial compared to other uses

FWPCA = Federal Water Pollution Control Act here by the term water conservation, is reducing consumptive use and removal from further "beneficial use." Thus, when water is "lost" by soaking into the ground, it may or may not be consumed depending on the availability of the groundwater for further use. Agricultural conservation also includes removal of marginal lands from production, improving cultivation, and planting practices such as avoiding cultivation which interferes with root systems, controlling weeds, and mulching with crop residues. Water can also by conserved by crop switching. Since different crops are known to have different water-use efficiencies, water may be saved by changing crop patterns away from water intensive crops like alfalfa to crops such as vegetables or wheats which use less water per acre or less per dollar of crop values.

Municipal conservation techniques are less well-established and less likely to be a useful alternative in the West because so few large municipalities exist in the eight-state study area, particularly in the vicinity of likely developments. However, the Carter Administration has suggested that municipalities can conserve 15 percent of their water, and many western areas have experience in water conservation because of having dealt with recent drought conditions.

C. Decreasing or Eliminating Some Water Uses

Policymakers may also choose to meet only a part of future water needs in the West and, therefore, decrease or eliminate some water uses. This choice is the most radical category of alternatives, since it departs most drastically from past policies. If policymakers make this choice, they will be changing the conception of water as an unlimited birthright, a conception which has been the dominant view of water resource management and administration in the West.[1]

Consideration of this general choice to decrease or eliminate some water uses has apparently become more common in the policy system as the physical limits on water have become more obvious and as opposition to traditional augmentation policies has increased. However, this alternative probably faces more serious constraints than either augmentation or conservation do. Many barriers exist largely as a consequence of the entrenched interests which have developed around water resource management in the West. Agricultural interests are firmly entrenched in the West; in fact, agriculture is a prime economic activity in each of the eight states in the study area. Moreover, irrigated agriculture which is already heavily subsidized by the regulatory system, is probably least able to cope with such a policy unless these policy changes explicitly favor agriculture over other water users. For example, if water prices increased substantially, either as a result of increased competition or as a direct government policy, it would be much more likely for agricultural uses to be limited rather than other uses (such as energy development).

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[1] For a discussion of the development of federal water resource management based on this view of water, see Ingram, Helen, and J.R. McCain. "Federal Water Resources Management: The Administrative Setting." Public Administration Review, Vol. 37 (September/October 1977), pp. 448-55.

Such a basic change in water would also be constrained by political factors associated with the long and complex history of water resource management. As discussed in Section 4.2.2 above, the water policy system is characterized by an extremely fragmented federal administrative system,[1] piecemeal and incremental state appropriation systems, and considerable uncertainty about water rights such as those over federal and Indian rights. In part, the regulatory system represents a logical approach to managing an extremely complex, changing policy area. However, this system impedes more comprehensive approaches to water policy. For example, region-wide or basin-wide water management may be required in order to make effective and equitable decisions about decreasing or eliminating some water uses. However, such comprehensive approaches would require vast changes in state water appropriation systems and, probably, in existing interstate compacts.

No comprehensive evaluation of the alternative to decrease or eliminate some water uses will be made in this chapter. However, basic choices between incremental and comprehensive policies are likely to become more focused as more and more demands are placed on water resources. Thus, some general comparisons are made among this alternative, augmentation, and conservation. Comprehensive policy choices for dealing with water availability problems and issues are also discussed in Chapter 13.

4.3.3 Evaluation of Alternatives

A. Evaluation Criteria

Five basic criteria for evaluating and comparing alternative policies and implementing strategies were identified in Chapter 3. These are: effectiveness, efficiency, equity, flexibility, and implementability. Each of these criteria will be applied to the evaluation of alternative water policies. As shown in Table 4-5, each criterion is defined in terms of the substance of water availability problems and issues. That is, these criteria are defined taking into account the political and social context of water availability issues in the West (4.2.2) and are related to the policy objectives outlined above (4.3.1).

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[1] Ingram and McCain traced this fragmented system directly to conceptions of water as unlimited. They state: "Because the benefits of water policy are so various and all uses are seen as compatible...the pattern of groups and individuals articulating demands is extremely compatible." Ingram, Helen, and J.R. McCain. "Federal Water Resources Management: The Administrative Setting." Public Administration Review, Vol. 37 (September/October 1977), pp. 448-55.

These criteria reflect the kinds of trade-offs which policymakers will have to face up to as demands for scarce water resources continue to increase. That is, it will probably be impossible to choose either individual or combinations of alternatives which satisfy all of these criteria. Hence, this assessment is intended to inform policymakers generally about the consequences of different choices and to identify which alternatives are likely to contribute most to achieving a particular value.

As suggested by the descriptions provided in Table 4-5, these five criteria answer two general kinds of questions. The first is "how well can water needs be met?" Thus, attention is given to how much water can be saved or added to existing supplies, what are the costs and benefits of different options and which individuals, groups, and sectors in society will be benefited or harmed. The second general question is "what is the best process for accommodating water needs?" In part, this question refers to whether or not specific options can be implemented and are flexible enough to be adapted as water problems and needs change. However, this question also consists of another aspect--whether or not alternatives are capable of incorporating diverse participation in the policymaking process. As suggested in Section 4.2, conflicts over access to policymaking and the appropriate roles and responsibilities of various participants are a dominant theme in the policy system. This is perhaps most notable with respect to recent reactions by western states to federal proposals, but it also includes disputes among and within states and between the public and private sectors. If these demands are not heard in the policymaking system, current tendencies toward legal contention and the often fragmented and piecemeal mechanisms for policymaking may prove to be incapable of resolving conflicts over which interests will have their water needs met.

B. Evaluation of Augmentation

This section evaluates and compares six specific alternatives for augmenting water supplies:

- Surface water development
    - Interbasin transfer
    - Intrabasin transfer

- Groundwater development
    - Groundwater storage
    - Groundwater mining

TABLE 4-5: EVALUATIVE CRITERIA AND MEASURES

CRITERIA	AS APPLIED TO WATER AVAILABILITY	MEASURES
Effectiveness Achievement of policy objective	How much water can be added or saved? Does it avoid or mitigate the problem?	Quantitative: Gallons or acre-feet per year Percentage reduction in water requirement Qualitative: Degree to which the problem is avoided Degree to which problem is mitigated
Efficiency Costs, risks, and benefits	What are the economic costs and benefits of saving a given quantity of water? What are the economic and environmental risks? How is water quality affected? Are environmental values such as instream uses and natural beauty affected?	Quantitative: Dollar costs per unit of energy produced Percentage increase in costs of energy product Qualitative: Acceptability of risks Degree to which water quality is improved or degraded
Equity Distribution of costs, risks, and benefits	How are costs, risks, and benefits distributed among˜the states of the western region? Are there interregional consequences? How are agricultural interests affected compared to energy industry interests?	Qualitative: States which are benefited or deprived Degree to which interregional conflicts are increased or decreased
Flexibility Adaptability to locational needs and changes over time	How well do alternatives allow for conditions at different locations? Is the option reversible?	Qualitative: Degree to which locational variances are obtainable Degree of reversibility Degree of state and local responsibility
Implementability Adoptability and acceptability	How difficult will it be to change existing political, and regulatory structures? How will parties-at-interest respond? How difficult will it be to administer? Are the processes for making choices open to broad participation?	Qualitative: Degree of innovation required (are new institutions or laws required, or can it be achieved with existing regulatory structure?) Degree to which stakeholders are likely to respond positively or negatively Degree to which decisionmaking processes are open to participation Quantitative: Dollar costs of administration

- Environmental modification
    - Weather modification
    - Vegetation management and phreatophyte control

(1) How Much Water Can Be Added?

Considerable uncertainty exists regarding the quantities of water which can be added to existing supplies by these augmentation alternatives. For intrabasin transfers, this is largely because so many impoundments and diversions already exist that few acceptable locations may remain.[1] For other alternatives, uncertainty is due to inadequate knowledge derived from experience based on actual applications in the eight-state study area. This constraint is particularly true regarding groundwater storage, weather modification, and vegetation management.

Given this uncertainty, several alternatives appear to have the potential to add large quantities to regional water supplies. Interbasin transfers are potentially large sources of water, particularly if water from the Columbia and UMRB's are diverted to the upper Colorado. Although these options face severe institutional constraints,[2] one estimate suggests that several million acre-feet can be augmented per year.[3]

Groundwater usage and weather modification can also increase supplies on a region-wide scale. If groundwater is mined, supplies can apparently be increased by millions of acre-ft/yr.[1] However, since continuous mining could deplete supplies and limit surface water recharge in a relatively short time, for example, in 10 to 20 years in Arizona at current rates, it is more reasonable that groundwater would be mined for a very short time and subsequently used up to recharge rates. Weather modification, if widely used, could also provide significant increases in water supplies. Although some estimates suggest that the success of this option varies considerably by location and yearly conditions,[2] others have found it to offer the greatest potential for augmenting natural water supplies.[3]

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[1] Since transfers and impoundments redistribute water from one area to another, rather than adding to total water supplies, suitability of locations is critical to the long-term use of this option. See National Water Commission. Water Policies for the Future, Final Report to the President and the Congress of the United States. Washington, D.C.: Government Printing Office, 1973, pp. 319-33.

[2] The Colorado River Basin Project Act, Pub.L. 90-537, 82 Stat. 885 (1968) currently prohibits transfers from the Columbia River, and the Yellowstone River Basin Compact of 1950, 65 Stat. 663 (1951) requires approval of Wyoming and Montana for interbasin transfers (see Section 4.3.3.B.5).

[3] A 2 to 10 million acre-foot diversion would represent 1 to 5 percent of the net water supply of Washington. See U.S., Department of the Interior, Bureau of Reclamation. Westwide Study Report on Critical Water Problems Facing the Eleven Western States. Washington, D.C.: Government Printing Office, 1975.

Other augmentation choices are more limited to specific areas or locations. Although not an effective choice for increasing supplies in a river system, intrabasin transfers have been considered in southern and central Utah, western Colorado, and along the Yellowstone River in Wyoming and Montana.[4] Augmentation by groundwater storage is geographically limited by the location and accessibility of large aquifers. However, one estimate suggests that underground storage could reduce evaporation losses in the Colorado River Basin that would save

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[1] See National Water Commission. Water Policies for the Future, Final Report to the President and the Congress of the United States. Washington, D.C.: Government Printing Office, June 1973, pp. 232-45.

[2] MacDonald, J.F., et al. Weather and Climate Modification: Problems and Prospects, Vol. I and II. Washington, D.C.: National Academy of Sciences, National Research Council, n.d.

[3] U.S., Department of the Interior, Bureau of Reclamation. Westwide Study Report on Critical Water Problems Facing the Eleven Western States. Washington, D.C.: Government Printing Office, 1973, p. 442.

[4] Ibid., pp. 143-49; and National Petroleum Council. "Water Availability," in National Petroleum Council, Committee on U.S. Energy Outlook. U.S. Energy Outlook. Washington, D.C.: National Petroleum Council, 1972, pp. 245-48.

1 million acre-ft/yr, assuming complete conversion from surface storage.[1]

The potential for upland vegetation management to increase runoff is based on the quantities of water lost to evaporation and transpiration by plants--approximately 90 percent of the annual precipitation in the Colorado River Basin. If evapotranspiration in the Colorado River Basin were reduced 1 percent, surface water supply could be increased by an average of 1.75 million acre-ft/yr.[2] However, upland vegetation management is limited to about 16 percent, or 26 million acres of the basin since so much area is covered by sparse vegetation which allows little opportunity for control.

Evaporation losses can also be controlled by removing nonproductive vegetation in streams and stream beds. Although it has been estimated that this alternative could save several million acre-ft/yr on a nationwide scale,[3] it is unclear how extensively or effectively it could be used in the West. However, experiments in the Southwest indicate that about 14,000 acre-ft/yr could be added by removing 6,000 acres of saltcedar and mesquite along the Rio Grande and about 40,000 acre-ft/yr by removing 11,000 acres of phreatophytes along the Gila River in southern Arizona.[4]

(2) What Are the Costs, Risks, and Benefits?

Economic costs for interbasin and intrabasin transfers would probably be higher than for any other alternative. Estimates depend on interest rate, flow rate through pipelines, and construction and operation costs dependent on location. For pipelines transporting about 30 acre-feet per day, costs will range from 3 to 7 dollars per acre-foot per mile.[1]

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[1] U.S., Department of the Interior, Bureau of Reclamation, and U.S., Department of Agriculture, Soil Conservation Service. Final Environmental Impact Statement: Colorado River Water Quality Improvement Program; Vol. I: Statement and Appendices. Denver, Colo.: Bureau of Reclamation, Engineering and Research Centers, 1977, p. II-30. This assumes a 50 percent reduction in the existing 2 million acre-feet of water that currently evaporates from major storage reservoirs.

[2] Hibbert, Alden R. "Vegetation Management For Water Yield Improvement in the Colorado River Basin." Paper presented at the Annual Meeting of the Colorado River Water Users Association, Las Vegas, Nevada, December 1977.

[3] National Water Commission. Water Policies for the Future, Final Report to the President and Congress of the United States. Washington, D.C.: Government Printing Office, 1973.

[4] Ibid, pp. 353-54.

Larger scale federal projects, transporting about 1,000 acre-feet per day, cost $0.60 to $1.10 per acre-foot per mile.[2] Interest rates for federally supported water projects have ranged from 3.5 percent to 6 percent. Costs will be highest for long-distance transportation and small throughputs. For example, BuRec has studied the feasibility of diverting water from the Green River in the Upper Colorado to Gillette, Wyoming, 225 miles away via the North Platte River and pipelines. Assuming existing reservoirs are used, capital costs for pipes and pumping stations would be about $430 million and operating costs about $2.6 million per year. Total project costs would be about $132 per acre-foot.[3]

Although less expensive than transfers, groundwater storage and mining would require fairly large economic investments for pumping systems to store and/or retrieve the water. Estimates of pumping costs for groundwater mining in the Madison aquifer in Montana range from $30 to $50 per acre-foot.[4] Costs of groundwater storage can be twice this high, depending on how water is introduced into the aquifer.[5] The pumping systems (usually required for deep aquifers) may increase costs to as much as $100 per acre-foot. If aquifers are shallow, large wells or percolation ponds can be used to reduce costs. Costs of groundwater storage and mining also will increase if water from aquifers has to be transported to where it is used.

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[1] Gold, Harris, and D.J. Goldstein. Aspects of Water Impact Analysis in Coal Conversion, Draft Report. Cambridge, Mass.: Water Purification Associates, 1978.

[2] Water Purification Associates Staff. Personal Communication, November 1978.

[3] U.S., Department of the Interior, Bureau of Reclamation. Appraisal Report on Montana-Wyoming Aqueducts. Billings, Mont.: Bureau of Reclamation, 1972.

[4] Montana, Department of Natural Resources and Conservation, Water Resources Division. Which Way? The Future of Yellowstone Water, draft. Helena, Mont.: Montana Department of Natural Resources, October 1976.

[5] U.S., Army Corps of Engineers, Phoenix, Arizona. Personal Communication, June 1978.

Economic costs of weather modification, uplands vegetation management, and phreatophyte removal are more uncertain, but probably cost less than the options described above. Weather modification has been estimated at $2 to $3 per acre-foot.[1] Uplands vegetation management has been estimated at about $1 per acre-foot for commercial forests in Montana, Wyoming, Colorado, Utah, New Mexico, and Arizona[2] and up to $50 per acre-foot in Chapparal areas.[3] Phreatophyte removal costs have been estimated at $14 per acre-foot for areas in Colorado, Utah, Arizona, and New Mexico.[4]

Other costs and risks are associated with these alternatives. Both surface and groundwater impoundments will lose water. In the UCRB, approximately 14 percent of total withdrawals are lost to evaporation from surface impoundments.[5] Storage will eliminate losses to evaporation, but seepage can still occur.

Nearly every augmentation alternative will result in environmental costs and risks. Surface water diversions and storage projects have been severely criticized (see Section 4.2.2 above) because of damage to scenic and wilderness areas and decreased stream flows in areas of the source of the diversion. Although groundwater storage does not appear to be environmentally damaging, groundwater mining raises environmental concern because recharge rates in surface streams would probably be reduced.

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[1] Weisbecker, Leo W. The Impacts of Snow Enhancement. Norman, Okla.: University of Oklahoma Press, 1974, p. ix.

[2] National Water Commission. Water Policies for the Future, Final Report to the President and Congress of the United States. Washington, D.C.: Government Printing Office, 1973, p. 357.

[3] Average cost for vegetation management in Chapparal is estimated at $20 per acre-foot. See Hibbert, Alden R. Vegetation Management for Water Improvement in the Colorado River Basin: Summary and Assessment. Paper presented at the Colorado River Water Users Association Annual Meeting, Las Vegas, Nevada, 1977.

[4] National Water Commission. Water Policies for the Future. p. 357.

[5] U.S., Department of the Interior, Water for Energy Management Team. Report on Water for Energy in the Upper Colorado River. Denver, Colo.: Water for Energy Management Team, 1974.

Vegetation management raises both aesthetic and ecological questions. Phreatophytes characteristically provide wildlife habitat, and treatment of riparian areas to remove phreatophytes can increase stream temperatures which could harm fish populations.[1] Upland vegetation management in forest areas, particularly clear-cutting of forests, could also threaten wildlife habitats and degrade scenic and aesthetic values.[2]

Weather modification would apparently result in less adverse environmental consequences. Although weather modification may contribute to hail damage, floods, avalanches, and biological changes, risks of these consequences appear low if the technology is used correctly.[3] Ecological research to date indicates that catastrophic ecological impacts should not be expected, although some relatively small impacts could occur to some plant and animal species.[4]

(3) How Will Costs, Risks, and Benefits Be Distributed?

Serious questions have already arisen regarding how equitably several of these alternatives will distribute costs, risks, and benefits. This has been particularly true for water transfers, impoundments, and storage projects. It is difficult if not impossible to calculate in economic terms the range of values involved in transferring water from one basin or subbasin to another. For example, the values of water for economic growth, hydroelectric production, recreation uses, floating commercial vessels, supporting aquatic life, and providing scenic and aesthetic amenities may need to be compared to the values of transporting water to support energy resource development.[5] Even if these values could be expressed in economic terms, considerable uncertainty exists regarding long-term projections of costs, including construction costs and cost recovery of these projects.

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[1] National Water Commission. Water Policies for the Future, Final Report to the President and the Congress of the United States. Washington, D.C.: Government Printing Office, June 1973, pp. 354-58.

[2] Hibbert, Alden R. Vegetation Management for Water Yield Improvement in the Colorado River Basin: Summary and Assessment. Paper presented at the Colorado River Water Users Association Annual Meeting, Las Vegas, Nevada, December 1977.

[3] Weisbecker, Leo. The Impact of Snow Enhancement. Norman, Okla.: University of Oklahoma Press, 1974.

[4] National Water Commission. Water Policies for the Future, p. 349.

[5] For a discussion of economic issues and equity associated with interbasin transfers, see Ibid., pp. 319-31.

However, some general choices regarding who will pay and who will benefit can be addressed. Alternatives for transferring, storing, and mining water will ultimately require the taxpayer to pay, since the capital and operating costs will probably necessitate federal authorizations. This would be equitable if water is transferred to enable energy resource development in order to meet national energy goals. Since areas receiving the water would gain other benefits, for example those associated with economic growth, they can be expected also to pay increased costs. Hence, recent proposals for states to share project costs with the federal government could redistribute some of the costs to the prime beneficiaries. If the ultimate users of water are asked to pay the costs of water augmentation, energy industries could probably afford most of these water prices, while agricultural interests may only be able to afford weather modification and the least expensive vegetation management alternatives.[1]

Groundwater mining and weather modification raise other equity questions. If groundwater is continuously used beyond recharge rates, future water users will almost certainly pay the costs of present use. Weather modification also raises equity questions about present and future uses. This is because of the uncertainty about downwind impacts of weather modification, and because many impacts may take years to detect.[2] However, weather modification appears to raise few of the equity questions associated with the transfer, storage, and diversion alternatives. This is in part because total costs are considerably less, but also because total stream flows are actually increased rather than redistributed.

(4) Are the Alternatives Flexible?

Questions about the flexibility of these alternatives include reversibility and adaptability for use in different locations. Reversibility among the options varies between those choices which require major capital-intensive structures and those which do not. Interbasin and intrabasin transfers are probably the least reversible, since they generally take a decade or longer to build and, once a project is undertaken, long-term commitments are made to large sums of capital and to relatively inflexible resource allocation procedures.

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[1] It is generally estimated that water for agriculture is economic up to about $25 per acre foot while water for energy may be economic up to about $200 per acre-foot. These ability-to-pay questions are addressed below in Section 4.3.3.C.

[2] National Water Commission. Water Policies for the Future, Final Report to the President and the Congress of the United States. Washington, D.C.: Government Printing Office, June 1973, p. 349.

Groundwater mining and storage also require large capital investment, although less than for water transfers. Weather modification, upland vegetation management, and phreatophyte removal offer the greatest degree of flexibility in terms of sunk capital costs. However, once commitments were made to upland vegetation management and phreatophyte removal, relatively irreversible or certainly long-term impacts to forest lands and streams would occur.

Variation also exists in the adaptability of these options. Riparian phreatophyte removal is generally limited to the lower Colorado River Basin, although removal of vegetation from conveyance systems and irrigation ditches could be used in most areas of the West. Upland vegetation management also has widespread potential throughout the eight-state study area, although it is estimated to be most effective in the forest lands of Montana and Wyoming.[1] Similarly, weather modification appears generally applicable throughout much of the West, although the most appropriate climates and topography occur along the Rocky Mountains.

Other augmentation alternatives are more limited. Both groundwater storage and mining are limited to suitable and accessible hydrologic areas, eliminating many deep aquifers which are inaccessible using currently available technologies. Intrabasin transfers within the Colorado River Basin are probably limited by general water shortages and political conflicts over water usage. Interbasin transfers are most likely from the Pacific Northwest and the Northern Great Plains. However, as noted above, interbasin transfers from the Columbia River are currently prohibited by law and transfers from the Yellowstone require the consent of both Wyoming and Montana.

(5) Can the Alternatives Be Implemented?

Implementation of augmentation alternatives will be constrained by current political conflicts and by the need for changes in existing institutions, laws, or regulations. The most serious constraints probably exist for water storage and transfers. Interbasin transfers from the Columbia River cannot even be subject to a detailed study under current law,[1] and transfers from the Yellowstone would require agreement among signatories to the Yellowstone River Basin Compact. Further, impoundments in many areas of the Colorado River Basin and a few areas of the UMRB are precluded by the Wild and Scenic Rivers Act. Transfers and impoundments are also constrained by the current political system, including general opposition by the Carter administration and widespread opposition among environmental interest groups.

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[1] National Water Commission. Water Policies for the Future, Final Report to the President and the Congress of the United States. Washington, D.C.: Government Printing Office, June 1973, p. 357.

Underground water storage and mining projects will be impeded in some states by existing groundwater law. In Arizona, for example, groundwater is a private resource conveyed with the land, excluding underground streams with defined beds. Thus, surface waters recharged from the ground become landowners' property and are outside of governmental control.

Weather modification, upland vegetation management, and phreatophyte removal can be expected to generate substantial opposition from environmental interest groups and other stakeholders. Weather modification has been opposed because of potential damage to natural ecological conditions. The National Park Service is also opposed to weather modification unless it can be demonstrated that modification will not influence the natural or historic environments of National Park System areas.[2] Upland vegetation management and phreatophyte removal will almost certainly generate environmental opposition. This will be particularly true regarding attempts to remove vegetation from streams or stream beds and to clearcut forests.

(6) Summary of Augmentation Alternatives

Table 4-6 summarizes augmentation alternatives across each evaluative criteria. This information indicates that, if water availability were the sole criterion, augmentation alternatives can apparently provide needed quantities of water throughout the eight-state study area. Significant quantities of water can be added by each specific alternative, particularly by interbasin transfers. Most alternatives appear more effective in particular locations--interbasin transfers are particularly suited to the northern states (Montana, Wyoming, and Utah), weather modification to the central Rocky Mountain (Utah, Wyoming, and Colorado), and phreatophyte removal to the Southwest (southern Utah, Arizona, and New Mexico). Uplands vegetation management and groundwater mining appear more applicable region-wide. However, it is not

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[1] Colorado River Basin Project Act. Pub. L. 90-537, 82 Stat. 885 (1968).

[2] National Park Service, Glen Canyon National Recreation Area, Page, Arizona. Personal Communication, April 1978.

TABLE 4-6: SUMMARY EVALUATION OF AUGMENTATION ALTERNATIVES

CRITERIA	MEASURES	FINDINGS
Effectiveness How much water can be added?	Acre-feet per year	Millions of acre-feet per year can be added over the long term interbasin transfers. Groundwater mining may add millions of acre-feet for the short term. Weather modification can add large supplies, particularly in the Rocky Mountains. Intrabasin transfers, groundwater storage, upland vegetation management, and phreatophyte removal can add hundreds of thousands acre-feet, although none of these options appear applicable region-wide. Considerable uncertainty exists regarding the long-term effectiveness of all options.
Efficiency What are the economic and environmental costs, risks, and benefits?	Dollars per acre-foot	Interbasin and intrabasin transfers are the least economic options, with costs ranging from $50 to $300 per acre-foot (interbasin) and $30 to $100 per acre-foot (intrabasin). Costs of groundwater mining range from $30 to $50 per acre-foot. Groundwater storage can cost as much as $100 per acre-foot if aquifers are deep. Weather modification ($2 to $3 per acre-foot) and upland vegetation management in commercial forests ($1 per acre-foot) appear the least expensive. Phreatophyte removal has been estimated at $14 per acre-foot.
	Environmental costs and risks	Potential damage to scenic and wilderness areas from transfers, impoundments, vegetation management, and phreatophyte removal. Most widespread environmental and ecological risks probably associated with vegetation management and phreatophyte removal. Groundwater mining and surface impoundments will reduce stream flows in some areas. Environmental and ecological risks also are associated with weather modification, although they appear low, given current knowledge base.
Equity How will costs, risks, and benefits be distributed?	Distribution of costs and risks	Taxpayers are likely to pay for transfers and groundwater storage and mining since capital costs will require government subsidies. Recipient states will share some of these capital costs if new water policy is adopted by Congress. Future generations will pay for groundwater mining and face the risks of weather modification. Environmental interests generally face the greatest risks associated with these choices.

TABLE 4-6: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity (Continued)	Distribution of benefits	Depending on the mix of alternatives chosen, energy development interests and UCRB states are likely to be prime beneficiaries. If interbasin transfers are used, the entire region is more likely to benefit.
	Ability to pay	If users are asked to pay the cost, energy industries could probably afford the increased prices. Agricultural interests could probably afford only the costs of weather modification and vegetation management of commercial forests.
Flexibility Can augmentation alternatives be applied under different conditions and over time?	Reversibility	Capital-intensive alternatives, including transfers, impoundments, and possibly groundwater storage and mining, require long-term commitments and relatively inflexible resource allocation procedures. Weather modification, upland vegetation management, and phreatophyte removal offer the greatest flexibility in capital expenditures. Upland vegetation management and phreatophyte removal can cause relatively irreversible or long-term impacts to streams and forest lands.
	Adaptability	Upland vegetation management and weather modification have widespread applicability across the West. Phreatophyte removal appears most effective in the arid southwest. Groundwater mining and storage is limited to suitable and accessible hydrologic areas. New intrabasin transfers are probably excluded from most areas of the Colorado River Basin. Interbasin transfers are generally limited to the northern states.
Implementability How difficult will it be to enact and implement?	Degree of innovation or change in existing institutions, laws, or regulations	Projects to transfer water from the Columbia River are prohibited by federal law and transfers from the Yellowstone require consent of both Wyoming and Montana. The Wild and Scenic Rivers Act will limit some transfers, particularly in the UCRB. Underground mining and storage will be constrained by existing groundwater law in some states. Legal uncertainties may constrain weather modification.
	Acceptability	Weather modification, upland vegetation management, and phreatophyte removal are expected to generate substantial opposition from environmental interest groups. Transfers and impoundments will generate natural and regional political opposition.

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clear these alternatives would be effective over the long term. Groundwater mining appears to be most limited in this regard, and uncertainty with regard to long-term impacts is greatest with weather modification.

When economic and environmental costs and risks, and social and political values are considered, many of these choices become less attractive. Interbasin and intrabasin transfers and, to a somewhat lesser extent, groundwater mining and storage will require high and generally irreversible commitments of capital and could provide water at costs higher than current water prices throughout most of the West. Although energy resource developers could probably afford these increased costs, irrigated agriculture almost certainly could not. In the end, the taxpayer or energy consumer would pay at least part of these dollar costs. Further, interbasin and intrabasin transfers and storage projects raise serious environmental questions because of threats to scenic and wilderness areas and reduction of stream flows. Transfers also generated considerable political opposition and are constrained by current laws and interstate compacts. Hence, although transfers, impoundments, and diversions appear to be the most effective choices, they are problematic with regard to several other values.

Upland vegetation management and phreatophyte removal raise the most serious questions about environmental costs and risks and will probably be unacceptable choices for many stakeholders. Phreatophyte removal threatens streams and stream beds and, thus, the habitats of native species, some of which may be endangered. Upland vegetation management is most environmentally damaging if forest and chapparal lands are clearcut.

Weather modification also will necessitate trade-offs, but apparently to a lesser degree than most of the other options. Weather modification is economically efficient, can provide environmental benefits by increasing stream flows, and appears to be more flexible and implementable than most augmentation alternatives. However, weather modification involves high degrees of uncertainty about long-term impacts and damage liability and has generated opposition from stakeholders who oppose modifying natural conditions and processes.

C. Evaluation of Conservation

This section evaluates and compares five specific alternatives for increasing the use of existing water supplies:

- Choice of energy conversion technology;
- Cooling and process designs for energy conversion technologies;

- Irrigation technologies;
- Crop selection;
- Reduction in municipal usage.

Several other specific alternatives such as use of municipal wastewater for energy facility cooling, may be appropriate in the future but are not addressed in this report because of inadequate information.

(1) How Much Water Can Be Saved?

Energy

Policymakers may be able to minimize or, perhaps, avoid many water availability problems by employing the least water-intensive energy conversion facilities. As discussed above (Section 4.2.1), synthetic fuel processes generally require much less water per unit of energy than does electric power generation. As shown in Table 4-7, if a high degree of wet cooling is used, electric power generation can require from 1.4 to 2.7 times more water (gallons per million Btu's energy input) than gasification, liquefaction, and TOSCO II oil shale retorting. Among coal synthetic fuel technologies, Lurgi gasification requires from 25 to 45 percent more water than Synthoil liquefaction to produce an equivalent amount of energy at the same site. Thus, some water savings can be attained by choosing to produce different synthetic fuels. Water savings could be had by choosing to produce synthetic fuels instead of electricity.

Policymakers may also reduce water requirements for energy resource development by using a combination of wet and dry cooling (and water minimizing process designs) in conversion facilities. Table 4-7 summarizes the water saved as a function of the degree of wet cooling for five energy conversion technologies on an equivalent energy basis.[1] Intermediate wet cooling can reduce the total plant water requirements by as much as 32 percent for

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[1] For the Lurgi, Synthane, and Synthoil conversion technologies, high wet cooling assumes turbine condensers and gas compressor interstage coolers are entirely wet cooled. Even for a high degree of wet cooling more than 50 percent of the unrecovered heat is economically dissipated either directly (as up a stack) or indirectly (through either air or dry cooling). For electric power generation all of the unrecovered heat is dissipated by the turbine condensers. In the intermediate case, wet cooling is used for 10 percent of the load on the condensers and all of the load on the interstage coolers. In the minimum practical coolers case, wet cooling handles 10 percent of the load on the condensers and 50 percent on the interstage coolers.

TABLE 4-7: WATER CONSUMPTION AND POTENTIAL SAVINGS FOR COAL CONVERSION TECHNOLOGIES

TECHNOLOGY	WATER CONSUMED FOR HIGH WET COOLING[a] (gallons per million Btu)	WATER SAVED INTERMEDIATE WET COOLING[b]		WATER SAVED MINIMUM WET COOLING[b]	
		PERCENT	GALLONS PER MILLION BTU	PERCENT	GALLONS PER MILLION BTU
Power Generation					
Btu (e)	125-155	67-77	96-106	NA	NA
Btu (th)	42-53	67-77	33-36	NA	NA
Lurgi Gasification	20-29	21-32	6.1-7.0	27-42	7.9-9.3
Synthane Gasification	32-36	23-24	7.4-8.1	27-29	8.9-9.8
Synthoil Liquefaction	15-19	16-19	2.7-3.0	21-25	3.6-4.0

Btu = British thermal units
e = electric

NA = not applicable
th = thermal (34 percent efficiency)

[a] Range in amount of water used is due to site-specific variations.

[b] These data are from: Water Purification Associates. Aspects of Water Impact Analysis in Coal Conversion. Washington, D.C.: U.S., Environmental Protection Agency, 1978. Intermediate wet cooling assumes 90 percent of the load on the turbine condensers in synfuel's plants and 85 percent of the same load in power plants is dissipated with dry cooling towers. For synfuels, heat from the interstage coolers must also be dissipated; these are assumed to be all wet cooled in the intermediate case and 50 percent dry cooled in the minimum case. Since interstage coolers are not present in power plants, the intermediate case is also a minimum practical case from an economic viewpoint, but not a technological viewpoint.

Lurgi gasification and 77 percent for electric power generation. This could save about 96 to 106 gallons per million Btu's depending on where the power plant would be located.[1] Even larger quantities can be saved in synfuel processes by using minimum wet cooling, ranging from a maximum of 25 percent (Synthoil) to 42 percent (Lurgi). If it is assumed that energy resources will be converted on-site in the eight-state study area, minimum wet cooling could save about 400 thousand acre-feet of water per year by the year 2000.[2]

Agriculture

Much more ambiguity exists regarding water savings in agriculture.[3] For example, in spite of the fact that considerable research has been done on irrigation efficiency, it is not clear how much could be saved by using more efficient irrigation technologies. It does appear that irrigation efficiency can be improved.[4] For example, it has been estimated that conversion from flood and furrow methods to sprinkler methods can increase efficiency from below 50 percent to as high as 80 percent and thereby reduce per acre water demand by an average of 2.2 acre-feet for Upper Colorado River subbasins.[1] Apparently, per acre water demand can be reduced even more for water-intensive crops; average reductions for alfalfa have been projected at 3.6 acre-feet per acre in Arizona.[2] For the three subbasins above Farmington, New Mexico, it has been estimated that water requirements could be reduced about 250,000 acre-feet, based on uses and quantities consumed in 1975.[3]

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[1] The choice of a particular cooling system and the amount of wet cooling versus dry cooling in a wet-dry system is made on an economic basis, that is, by comparing the total annual costs of obtaining, transporting, treating, recirculating, and disposing of the water as well as the costs of constructing and operating the cooling towers. For additional details see Gold, Harris, et al. Aspects of Water Impact Analysis in Coal Conversion. Washington, D.C.: U.S., Environmental Protection Agency, 1977.

[2] This estimate is calculated by multiplying the maximum savings for each facility (see Table 4-8) by the number of facilities projected for the region, based on our Low Demand scenario for the year 2000. The Low Demand scenario, developed by the Stanford Research Institute, projects 28 gasification facilities, 2 liquefaction facilities, 17 electric power plants, and 35 oil shale retorts by the year 2000. For details on the Low Demand scenario, see White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[3] The evaluation of the effectiveness and efficiency of agricultural conservation benefits from work performed by Gary Parent for the Science and Public Policy Program.

[4] Efficiency refers to the ratio of water applied to that required for maximum plant growth and adequate soil leaching.

However, none of these studies quantifies water actually saved. As mentioned above, improved irrigation efficiency is not synonymous with "conservation," since much water withdrawn for irrigation is subsequently returned to its source. In fact, some studies have shown little if any water actually saved by improved irrigation efficiency.[4] Recognizing this uncertainty, improved irrigation efficiency probably can save water for other uses by reducing evaporation loss and water lost when return flows move directly to a saline lake or inaccessible groundwater systems.[5]

Perhaps even more uncertainty exists regarding water savings from crop selection. Substantial differences do occur in water requirements for different crops. In Arizona, shallow and deep vegetables require less than two acre-ft/yr per acre and wheats, barley, and oats require about 1.9 acre-ft/yr per acre. In contrast, cotton (3.0), crop pasture (3.1), and alfalfa (5.0) require substantially more water per acre.[1] Because water-intensive crops such as alfalfa and other forage crops are commonly grown in western states, water consumption could be reduced by growing less water-intensive crops. Although this option involves several risks (discussed below), it may be a consideration in some subbasins.

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[1] Utah State University, Utah Water Research Laboratory. Colorado River Regional Assessment Study, Part II: Detailed Analyses: Narrative Description, Data, Methodology, and Documentation, for National Commission on Water Quality. Logan, Utah: Utah Water Research Laboratory, 1975, p. 60.

[2] Pritchett, Harold R., and Bruce E. Boesch. Irrigation Improvement for the Wellton-Mohawk District. Wellton, Ariz.: U.S., Soil Conservation Service, 1977.

[3] Utah State University, Utah Water Research Laboratory. Colorado River Regional Assessment Study, Part II.

[4] Wendt, C.W., et al. "Effect of Irrigation Systems on Water-Use Efficiency and Soil-Water Solute Considerations," in Law, James P., and G.V. Skogerbee, eds. Proceedings of National Conference on Irrigation Return Flow Quality Management. Fort Collins, Colo.: Colorado State University, 1977.

[5] This idea has been supported on a nationwide scale by findings from U.S., Department of Agriculture, Soil Conservation Service. Crop Consumptive Irrigation Requirements and Irrigation Efficiency Coefficients for the United States. Washington, D.C.: Department of Agriculture, 1976. For an elaboration of this issue see Plotkin, Steven E., Harris Gold, and Irvin L. White. "Water and Energy in Western Lands." Paper presented at the American Water Resources Association Conference, Tucson, Arizona, November 1, 1977.

Municipal

Municipal conservation does not represent a comprehensive alternative in the West because there are so few large cities and most western towns rely on groundwater resources. However, a 15 percent savings as suggested by President Carter could represent an important reduction in the UCRB, where approximately 20 percent of annual withdrawal goes to Denver via interbasin transfer. If all of the 15 percent savings in Denver water use were subtracted from this interbasin transfer, 96,000 to 111,000 acre-feet could be saved.[2]

In summary, the total amount of water which can be saved in western states in our eight-state study area by the widespread use of these conservation alternatives is uncertain. However, careful choice of technology, use of water-saving cooling technologies, and perhaps, crop switching could significantly reduce water demands. While these reductions probably could not avoid water availability problems, they probably could mitigate many related conflicts.

(2) What Are the Costs, Risks, and Benefits?

Energy

The economic costs, risks, and benefits of water conservation for energy will largely depend on the price of water and how strictly conservation is defined. Water conservation by intermediate wet cooling for conversion facilities can be economical, but opting for minimum wet cooling will generally increase the costs of energy products. "High wet" cooling, appears to be the most economical choice for all coal conversion facilities if water costs less than about 25 cents per 1,000 gallons ($81 per acre-foot).[1] For synthetic fuel facilities, "intermediate wet" cooling becomes economical at between 25 cents to $1.50 per 1,000 gallons ($81 to $490 per acre-foot); and "minimum wet" is economical when water costs more than $1.50 ($490 per acre-foot). However, for power plants "intermediate wet" cooling does not become economical until water costs $3.65 to $5.87 per 1,000 gallons ($1,190 to $1,910 per acre-foot).[2]

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[1] U.S., Department of Agriculture, Soil Conservation Service. Crop Consumptive Irrigation Requirements and Irrigation Efficiency Coefficients for the United States. Washington, D.C.: Department of Agriculture, 1976.

[2] This estimate assumes a total yearly withdrawal in the Upper Basin of 3.2 to 3.7 million acre-feet, approximately 20 percent of which (640,000 to 740,000) goes to Denver. See U.S., Department of the Interior, Water for Energy Management Team. Report on Water for Energy in the Upper Colorado River. Denver, Colo.: Water for Energy Management Team, 1974.

Although the costs of water rights are now relatively small, the cost to transport water to a given site may not be. Except for synthetic fuels plants located near the mainstem of major rivers or near large reservoirs, the cost of transporting water is in excess of 25 cents per 1,000 gallons indicating that intermediate or minimum practical wet cooling is economically desirable for most of the study sites. However for power plants, high wet cooling is most desirable since the cost of transporting water is much less than $3.65 per 1,000 gallons.

Information summarized in Table 4-8 suggests the economic costs to energy developers if they are forced to use water-saving cooling technologies. The economic cost penalties for synthetic fuels facilities will be very small. For example, in the case of Lurgi, 1,920 to 2,140 acre-ft/yr can be saved in going from high to minimal wet cooling at a cost not exceeding 1.5 cents per million Btu of gas, or about 0.5 percent increase in the cost of the gas.[3] In contrast, the cost increase would be much higher for power plants, about 8 percent for intermediate wet cooling.[4]

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[1] Water rights typically cost $10 per acre-foot to $100 per acre-foot or 3 cents to 30 cents per 1,000 gallons. See Gold, Harris, et al. Water Requirements for Steam-Electric Power Generation and Synthetic Fuel Plants in the Western United States. Washington, D.C.: U.S., Environmental Protection Agency, 1977.

[2] These "breakeven" water costs vary by site. Breakeven costs for power plants are higher than for synthetic fuel facilities because of higher capital costs for dry cooling equipment for power plants. Gold, Harris, et al. Water Related Environmental Effects In Fuel Conversion. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[3] This assumes synthetic gas costs $3.00 per million Btu. At this price, intermediate wet cooling increases costs 0.3 percent, and minimum wet cooling increases costs 0.5 percent.

[4] This assumes electricity costs 2.5 cents per kilowatt-hour. This rate is below the national average but appears to be a reasonable approximation for the western states.

TABLE 4-8: ECONOMIC COSTS OF COOLING WATER SAVINGS[a]

TECHNOLOGY	CHANGING FROM "HIGH WET" TO "INTERMEDIATE WET" COOLING[b]		CHANGING FROM "HIGH WET" TO "MINIMUM WET" COOLING[c]	
	WATER SAVED (acre-feet/year)	COST	WATER SAVED (acre-feet/year)	COST
Power Plant (¢/kWh)	6,710-20,340[d]	0.11-0.18	NA	NA
Lurgi Gasification (¢/million Btu)	1,490- 1,670	0.15-1.03	1,920-2,140	1.18-1.32
Synthane Gasification (¢/million Btu)	1,790- 1,970	0.18-1.22	2,150-2,380	1.33-1.47
Synthoil Liquefaction (¢/million Btu)	1,690- 2,100	0.14-1.00	2,200-2,640	1.06-1.27

¢/kWh = cents per kilowatt-hour
¢/million Btu = cents per million British thermal unit
NA = not available

[a] These calculations assume water rights cost 20 cents per 1,000 gallons. Estimates are derived from Gold, Harris, et al. Water Related Environmental Effects in Fuel Conversion. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[b] For synthetic fuels plants, the high wet cooling case assumes that cooling for the interstage coolers and turbine condensers is 100 percent wet; the intermediate case assumes that cooling on the turbine condensers is 90 percent dry while the interstage coolers remain 100 percent wet. For power plants, cooling on the turbine condensers is 100 percent wet in the high wet case and 85 percent dry in the intermediate case; there are no interstage coolers in power plants.

[c] For synthetic fuels plants, the minimum wet case assumes that cooling on the turbine condensers is 90 percent dry and on the interstage coolers is 50 percent dry.

[d] Ranges reflect site-specific differences.

Environmentally, conservation of water use in energy conversion facilities will have a positive effect if water saved remains in the stream rather than withdrawn for use. While water savings per facility are not large, they could have a significant effect on streams with low flows or on a basin-wide scale if many conversion facilities are sited.

Agriculture

Economic costs of improved irrigation efficiency depend on the type of irrigation system, crop, acreage, and local and seasonal conditions.[1] One estimate for the Colorado River Basin is that the annualized cost of installing and operating a sprinkler irrigation system would be about $50 per acre.[2] However, estimates for specific areas can be much higher--for example, $64 to $148 total annualized cost per acre, depending on the size of the farm, in southern Arizona.[3] Using the $50 per acre estimate and assuming an average reduction in per acre demand of 2.2 acre-feet for the UCRB, the average cost would be about $22.00 per acre-foot. However, in the example discussed above for the three subbasins above Farmington the costs could be less--$13.89 to $26.32 per acre-foot to reduce withdrawals 250,000 acre-feet.[4]

Other factors influence the efficiency of this alternative. One of the long-term benefits of sprinkler irrigation systems appears to be economic savings from reduced labor requirements.[5]

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[1] Conservation for agriculture, including economic and environmental costs, risks, and benefits, will be further analyzed during the fourth year of this study.

[2] Utah State University, Utah Water Research Laboratory. Colorado River Regional Assessment Study, Part II: Detailed Analyses: Narrative Description, Data, Methodology, and Documentation, for National Commission on Water Quality. Logan, Utah: Utah Water Research Laboratory, 1975, p. 249.

[3] Wade, James C., et al. "Sprinkle Irrigation Technologies and Energy Costs: A Comparative Analysis of Southern Arizona Irrigated Agriculture." Paper presented at the American Water Resources Association Conference, Tucson, Arizona, October 31-November 3, 1977.

[4] Utah Water Research Laboratory. Colorado River Regional Assessment Study, Part II.

[5] Little data appears to be available for evaluating labor savings. However, the Soil Conservation Service estimates that irrigation labor can be reduced about 50 percent by mechanical irrigation. See Pritchett, Harold R., and Bruce E. Boesch. Irrigation Improvement Program for the Wellton-Mohawk District. Wellton, Ariz.: U.S., Soil Conservation Service, 1977.

And in some cases, the costs of salvaging water may be less than buying new water.[1] However, the basic economic problem for farmers appears to be capital rather than annual costs. Since irrigated agriculture in many areas of the West is only a marginally profitable enterprise,[2] capital costs are likely to be prohibitive for many farmers unless additional subsidies are provided. Further, under the current system, a large risk is associated with spending large amounts to improve irrigation efficiency. This is because appropriation systems may not allow a user to retain a right to salvaged water, since a downstream user may depend on the return flow (see Section 4.2.2.C).

Economics of crop switching are also difficult to estimate. In general, the per acre economic return for vegetables is greater than that for forage crops.[3] However, a comparison of the economic return must include the risks associated with crop switching. First, it is unclear that sufficient markets exist to support large scale increases in vegetable production. So, although some farmers may be able to obtain an economic advantage from crop switching, market-related risks discourage this option as a broad-scale alternative. Second, vegetable crops are more susceptible to weather damage (such as late freezes, floods, etc.) than are forage crops. Hence, in some years vegetables might provide a good economic return, but in years of adverse weather they may not return anything. Third, economic return is not the only decisionmaking factor. For example, many farmers have grown forage crops for decades and are not likely to be disposed to radical shifts in crop patterns.[4] In summary, the economic efficiency of agricultural alternatives is ambiguous since there appear to be economic advantages to the individual farmer but substantial market-related risks associated with crop switching. Further, these risks would increase as more farmers switched to vegetable crops. Since the effectiveness of this option would depend on broad utilization, for example within a subbasin, the overall economic efficiency appears to be negative.

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[1] This comparison is difficult to make since irrigation water charges are often based on acres irrigated rather than acre-feet of water delivered. Costs vary considerably across the West, ranging from $3 to $5 an acre (for low value crops) to $25 to $30 an acre (for high value crops such as orchards). U.S., Department of the Interior, Bureau of Reclamation Staff, Engineering Center, Denver, Colorado. Personal communication, June 28, 1977.

[2] In some areas of the West, irrigated agriculture is much more profitable and could apparently withstand higher production costs.

[3] This appears to be true even though vegetables generally cost more to produce.

[4] Other factors, such as the end use of forage crops, help to explain their abundance. Alfalfa, for example, is grown to support Arizona's dairy and cattle industries.

For irrigated agriculture, improved efficiency will have a positive environmental effect. Indeed, reduced salinity from agricultural runoff and from reduced salt concentration may be the primary benefit of more efficient irrigation systems. In the UCRB, agricultural irrigation accounts for about 60 percent of withdrawals from surface waters and return flow from this diversion contributes about 1.5 million tons of salt per year. It has been estimated that irrigation runoff accounts for about 40 percent of the salt concentration at Lee Ferry.[1] Utah State's Regional Assessment study estimated that upgrading on-farm efficiency to 80 percent would substantially reduce saline contamination attributable to agriculture.[2] It is much more difficult to estimate the environmental costs and benefits of crop selection beyond the general statement that reduced water consumption has a positive water quality and overall environmental influence.

Municipal

Since municipal conservation is such a limited option in the West, negligible environmental costs, risks, and benefits are associated with it. Whatever slight effects do occur are likely to be positive if water saved by municipal conservation reduces total stream withdrawals. Although several western states have recent experience with water conservation forced by drought, little data appears to be available for estimating economic costs associated with a 15 percent usage reduction.

(3) How Will Costs, Risks, and Benefits Be Distributed?

If ability to pay is used as an indicator of equity, conservation costs appear to be disproportionate for irrigated agriculture. For example, if water prices are increased as an incentive to improve irrigation efficiency or to switch crops, many farmers will be unable to afford an adequate water supply. One estimate suggests that, if water costs $200 per acre-foot, agriculture could experience a total cost increase of about 400 percent, whereas production costs of energy products would increase only 1 to 8 percent.[1] Although the profitability of irrigated agriculture varies considerably in the West, it will almost certainly be less able to afford price increases than energy resource development. In the Colorado River Basin, water for agriculture is estimated to have a maximum value of about $25 per acre-foot.[2] Some estimates suggest that the relatively high average annual costs of mechanical irrigation systems might be profitable if the water saved were used to irrigate idle lands so that total farm acreage could be productive.[3] However, as discussed above, very marginal increase in production costs could be prohibitive and in many states, farmers would be unable to retain the rights to "salvaged" water since this would reduce return flows. Thus, unless policymakers want explicitly to decrease or eliminate agricultural uses of water, conservation will probably require direct federal subsidies for new irrigation systems or quarantees for crop switching.

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[1] Salt content at Lee Ferry averages about 500 milligrams per liter (mg/ℓ), of which about 104 mg/ℓ have been attributed to salt loading and about 113 mg/ℓ to the concentrating effect of evapotranspiration in irrigation systems. Thus, water for irrigation accounts for about 40 percent of the salt concentration at Lee Ferry.

[2] Utah State University, Utah Water Research Laboratory. Colorado River Regional Assessment Study, Part II: Detailed Analysis: Narrative Description, Data, Methodology, and Documentation. Logan, Utah: Utah Water Research Laboratory, 1975, pp. 249-55.

These ability-to-pay issues raise further questions about decisions to develop the West's energy resources. If the conservation alternative is broadly applied as a means to ensure adequate water supplies for energy resource development, the citizen ultimately pays the bill. This may occur either directly in the form of increased costs for energy products (for example, if minimum wet cooling is used), or indirectly in the form of subsidies to irrigated agriculture. While these costs may or may not be large enough to be burdensome by themselves, to the individual citizen they are likely to be only part of the increased costs associated with developing the West's resources.

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[1] Two hundred dollars per acre-foot is approximately 60 cents per 1,000 gallons. For an elaboration of these estimates, see Anderson, Jay C., and John Keith. "Energy and the Colorado River." Natural Resources Journal, Vol. 17 (April 1977), p. 161.

[2] Anderson, M., J. Anderson, and J. Keith. The Demand for Agricultural Water in Utah. Logan, Utah: Utah Water Research Laboratory, PR-WG-100-4, 1973.

[3] Especially in the arid Southwest, most larger farms (over 100 acres) have large amounts of idle lands because water is insufficient to irrigate total farm acreage. For an elaboration of the economics of irrigated agriculture in Arizona, see Wade, James C., et al. "Sprinkle Irrigation Technologies and Energy Costs: A Comparative Analysis of Southern Arizona Irrigated Agriculture." Paper presented at the American Water Resources Association Conference, Tuscon, Arizona, October 31-November 3, 1977.

Moreover, they raise other political issues, such as the political feasibility of further subsidies for irrigated agriculture. While agricultural subsidies have been a long-term federal policy, they have been the subject of increasing political debate, and choosing conservation alternatives may force policymakers to decide just how valued irrigated agriculture is. Further, interregional conflicts may be increased. Since development of energy resources in the West would be used primarily to meet the needs of other regions, an equitable alternative may well be one which requires other regions to pay the largest share of the cost of providing adequate water and ensuring that water is still available for current uses.

It is more difficult to estimate whether some western states will pay disproportionate costs and risks or gain disproportionate benefits from conservation. Generally, if conservation is uniformly applied across the region, costs, risks, and benefits may be shared equitably. While some interests in the UCRB may be concerned that conservation would primarily benefit lower basin states, it appears more likely that water saved by a state would be largely used within the state to meet increased demands. If conservation is implemented by states, for example, to increase supplies available for energy resource development, costs and risks would be more localized. This would appear to be an equitable choice in order to generate the economic benefits of energy resource production. Further, since some states have already overallocated their shares of the Colorado, conservation may be a necessary decision in order to meet existing obligations.

(4) Are the Alternatives Flexible?

What is gained in equity may be lost in flexibility. Whereas equity is generally served by uniform application of laws and regulations, uniformity may reduce the ability of states and localities to meet particular demands and characteristics of specific areas. For example, if a policy requiring "best available conservation technology" were uniformly applied, it would negate knowledge about the importance of locational impacts in determining water availability problems and issues. Indeed, conservation is likely to be needed in different proportions in various areas of the West, depending on quantities of water locally available and demands. Flexibility also includes the need for state and local decisionmaking responsibility, which has been highlighted by recent conflicts among the western states and the Carter Administration regarding federal water policy. Thus, federal attempts to mandate uniform conservation policies which do not include strong state roles in formulating and implementing the policies are likely to be very difficult to enact.

Conservation alternatives oriented toward new technologies, such as water minimizing cooling technologies and mechanical irrigation systems, are generally not reversible, at least in the short-term, largely because of their capital cost. Two conservation alternatives, crop switching and municipal conservation, may not be as restrictive. Although crop switching would require changes in production techniques, including labor and equipment, once equipment is obtained several different kinds of crops can be grown in one year or from year to year. Reversibility of crop switching would largely depend on implementation strategy. If crop switching is mandated, it is likely that farmers would make more permanent commitments to one type of crop than if incentives were provided to grow several kinds of crops. Municipal conservation could probably be more or less restrictive, depending on yearly water availability.

(5) Can the Alternatives Be Adopted and Implemented?

As the recent conflicts between the Carter Administration and the western states indicate, changes in water policy management will probably be very difficult to enact and implement. If it is true that the nature of water resource management is fundamentally changing, from a situation of scarce but "unlimited" resources to one of region-wide shortages, then comprehensive policy and institutional changes are likely to be required to deal with future water conflicts. However, because water policy management has historically been so fragmented and incremental and because so many interests would be threatened, innovation will be very difficult to achieve.

Change appears particularly difficult for agricultural conservation. Although many institutional arrangements contribute to the current complexity of water policy, state appropriation systems and federal pricing policies may be most constraining to agricultural conservation. This is because, even if farmers could conserve large quantities of water, the "use or lose" aspects of these mechanisms mean that water "saved" by the individual farmer cannot be retained. Although several states have incrementally changed appropriation systems and Utah has proposed broad changes, the long and complex development of these systems suggest that region-wide change will be very difficult.

Adopting new conservation policies for energy conservation may be less constrained. This is in part because conservation for energy resource development appears more effective and efficient; that is, more water can be saved with less cost and fewer environmental problems. Thus, enactment of new water conservation laws or regulations for energy may not receive as much resistence from energy resource developers as agricultural conservation is likely to receive from agricultural stakeholders. Further, precedents exist in several areas, such as air quality control, for improving technological requirements on energy conversion facilities. So, for example, water-saving cooling technologies could be required for a developer to obtain a permit.

Implementation may also be constrained by the inadequacy of current institutional mechanisms to allow broad participation in decisionmaking before critical policy decisions are made and during the implementation process. For example, one of the causes of uncertainty about water rights and available water supplies has been the general exclusion of Indians and environmental interest groups in decisionmaking processes. Thus, these participants often resort to the courts as the only mechanism available for protecting their interests. Further, uncertainties about how the courts will define water rights makes it more difficult to plan comprehensively for water resource management. Although no participatory mechanisms would be able to avoid these problems completely, policy institutions have yet to develop any mechanisms to encourage comprehensive management and broad participation among parties-at-interest which also have decisionmaking authority. Implementation of water policy reforms at a regional level may benefit from experiences with institutions such as the Colorado River Salinity Control Forum which is designed to provide comprehensive, intergovernmental water quality management in the Colorado River.[1] Further, if policymakers choose to discourage some technologies to minimize water availability problems, cooperative siting mechanisms become a possible mechanism for more comprehensive and participatory policymaking.[2]

(6) Summary of Conservation Alternatives

Conservation alternatives are intended to help meet the needs of water users and thereby avoid the necessity of decreasing or eliminating some current water uses. Table 4-9 summarizes the potential effectiveness of conservation to achieve this objective as well as the trade-offs likely to occur if these alternatives are used. It appears uncertain whether the six alternatives evaluated in this section would eliminate potential water shortages, particularly those predicted for the UCRB by the year 2000. However, if conservation is adopted for energy, agricultural, and municipal uses, many water conflicts may be mitigated or avoided.

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[1] For a discussion of the Forum, see Chapter 5, "Water Quality."

[2] Siting is discussed in detail in Chapter 12 and is evaluated as a comprehensive policy alternative in Chapter 13.

TABLE 4-9: SUMMARY EVALUATION OF CONSERVATION ALTERNATIVES

CRITERIA	MEASURES	FINDINGS
Effectiveness How much water can be saved?	Percentage reduction in water requirements for energy facilities	Water requirements based on an equivalent amount of coal input can be reduced as much as 75 percent by siting synthetic coal facilities rather than electric power plants. Among synthetic fuel facilities, Lurgi requires about two-thirds and Synthoil requires about half as much as Synthane to produce an equivalent amount of energy. Large percentages of water can be saved if coal conversion facilities use water-saving cooling technologies rather than wet cooling. Power plant water requirements can be reduced by about 75 percent by intermediate cooling. Water requirements for synthetic fuels can be reduced by 16 to 32 percent (intermediate) and 21 to 42 percent (minimum wet cooling).
	Gallons or acre-feet per year	Four hundred thousand acre-feet per year can be saved by the year 2000 in the eight-state study area if water-saving cooling technologies are used. Although irrigation efficiency can be improved substantially by mechanical methods, actual savings are uncertain. Water savings can be attained by crop switching and mechanical conservation, but amounts are uncertain.
	Problems avoided or mitigated	Conservation probably will not by itself avoid water shortages or conflicts over water rights. However, many conflicts can be mitigated, particularly by conservation for energy uses.
Efficiency What are the economic and environmental costs, risks, and benefits?	Dollar costs per unit of energy produced	For synthetic fuel facilities, costs will increase .15¢ to 1.2¢ per million Btu's produced if intermediate wet cooling is used and 1.1¢ to 1.5¢ per million Btu's if minimum wet cooling is used. For power plants, intermediate wet cooling will increase costs .1¢ to .2¢ per kWh.
	Percentage increase in cost of energy product	Water-saving technologies will increase the cost of synthetic gas by a maximum of .5 percent and the cost of electricity by 4 to 8 percent.

TABLE 4-9: (Continued)

CRITERIA	MEASURES	FINDINGS
Efficiency (Continued)	Economic costs of agricultural production	Mechanical irrigation will increase production costs about 60 to 150 dollars per acre, or about $22.00 per acre-foot of water saved. These costs appear prohibitive for many farmers. Switching crops from forage to vegetable production would be economically beneficial, assuming adequate markets exist.
	Acceptability of risks	Agriculture conservation appears to require unacceptable risks. Farmers may lose rights to water saved. Availability of markets for vegetables is uncertain. Risks of conservation in energy resource development appear to be acceptable either because percentage cost increases are small or because costs would be passed on to consumer.
	Environmental quality	Conservation generally will have positive overall environment effects. The largest environmental benefit will be from improved irrigation efficiency which will significantly reduce saline contamination and could increase instream flows locally. Conservation for energy also will increase instream flows.
Equity How will these costs, risks, and benefits be distributed?	Ability to pay	Irrigated agriculture generally will be unable to afford the costs and risks of conservation. If water prices are increased, the costs of agricultural production would increase at a much higher rate than would the costs of energy resource production. Conservation will almost certainly be paid for by the consumer either directly by increased energy product costs of indirectly by increased government expenditures.
	State and regional impacts	Increased interregional conflicts can be anticipated as the West develops resources to meet needs of other regions and as other regions pay higher prices either for energy or to insure adequate water supplies. Increased conflict among Upper and Lower Basin states of the Colorado River can be anticipated as Upper Basin begins to use its full allotment.

TABLE 4-9: (Continued)

CRITERIA	MEASURES	FINDINGS
Flexibility Can conservation alternatives be applied under different conditions and over time?	Adaptability to locational differences	Uniform and equitable implementation strategies will probably sacrifice flexibility required to address location-specific situations.
	Degree of reversibility	Water minimization cooling technologies and mechanical irrigation systems are largely irreversible. Crop switching and municipal conservation appear reversible.
Implementability How difficult will it be to enact and implement the alternative?	Degree of innovation required	Comprehensive policies and innovative institutions may be required to adequately deal with the complex mix of water problems likely to arise.
	Acceptability	Stakeholders will almost certainly respond negatively to comprehensive changes. This is particularly true regarding agricultural conservation which could threaten state appropriation systems and BuRec pricing policies. Conservation alternatives for energy resource development may not receive as much resistance.
	Openness of decision-making processes	Current institutional arrangements do not allow broad participation by stakeholders contributing to the complexity and uncertainty about water rights and resource management.

Btu = British thermal unit
kWh = kilowatt-hour
BuRec = Bureau of Reclamation

Water conservation alternatives for energy resource development appear the most promising. Water requirements for energy facilities, representing a large percentage of private demands on available resources, can be reduced about 75 to 85 percent by opting for synthetic coal facilities rather than coal-fired steam-electric power plants keeping in mind that the product outputs are different. Among synthetic fuel technologies, Synthoil liquefaction requires less water than do Lurgi and Synthane gasification to produce an equivalent amount of energy. Water-saving cooling technologies can also save large percentages of water required for coal conversion technologies. Intermediate wet cooling can reduce water requirements about 15 to 30 percent, and minimum wet cooling can reduce the total requirements about 20 to 40 percent of those for a high degree of wet cooling. For power generation, the water saved can be as high as 80 percent. Water-saving cooling technologies are particularly attractive because they do not necessarily require high economic costs. Increases in the cost of the energy product for synthetic coal facilities will be less than 1 percent, even using minimum wet cooling. Although the percentage increase in product costs will be larger for electric power plants (about 8 percent), intermediate wet cooling will not be economic until the price of water increases to over $1,000 per acre-foot.

Water savings can probably be attained by the other alternatives as well, particularly crop switching. However, the actual quantities of water which can be saved are not known, and substantial economic and environmental costs and risks are associated with these choices. Economic risks of switching from forage to vegetable crops will be unacceptable for many farmers unless governmental subsidies or guarantees are provided. Improved irrigation efficiency and municipal conservation can probably produce only marginal water savings. Mechanical irrigation systems are very expensive but would produce environmental benefits by reducing saline contamination and increasing stream flows.

Policymakers will face complex trade-offs associated with the implementation of these alternatives and the distribution of costs, risks, and benefits. This assessment suggests that uniform implementation strategies which may distribute costs, risks, and benefits in an equitable way will probably sacrifice flexibility which is needed to address location-dependent problems and issues. Further, the need for uniform and more comprehensive water resource management comes at a time when western states and local governments are pushing for stronger roles in formulating and implementing policies which determine the kind and extent of growth in their area.

Based on this evaluation, water conservation for energy resource development may be the easiest set of alternatives to enact and implement because they can avoid many of these difficult implementation questions. That is, conservation for energy resource development can save large percentages of water, has less uncertainty associated with its effectiveness and efficiency, energy industries are probably better able to afford associated cost increases, and it appears easier to implement new regulations on energy resource development than on agriculture.

However, imposing conservation only on energy resource development neglects the apparent need for more comprehensive water resource management. The demands of growth in the West, the history of water uses, and the scarcity of water resources suggest that water policy should consider a mix of water uses, a variety of values, and locational circumstances. Thus, comprehensive water resource management will probably require new institutions, and there are compelling arguments for these institutions to be regional or basin-wide in scope, with states assuming primary responsibility. If states are unable or unwilling to develop these institutions, the probability of federal intervention increases.

4.4 SUMMARY AND COMPARISON OF WATER AVAILABILITY ALTERNATIVES

The western states are likely to face acute water shortages by the year 2000 particularly if energy resources are converted within the region. Table 4-10 summarizes and compares alternatives for augmenting and conserving water resources so that current and future water needs can be met. This evaluation indicates that substantial quantities of water can be added to existing supplies, perhaps enough to avoid water shortages in many areas of the West, if both augmentation and conservation are employed extensively. The most effective augmentation choices to meet this goal, potentially capable of adding millions of acre-ft/yr, appear to be interbasin transfers, weather modification, vegetation management, and phreatophyte removal. Although conservation alternatives appear generally less effective than augmentation, and more uncertainty may be associated with estimating the effects of each alternative, cooling technologies for energy facilities can save as much as 400,000 acre-ft/yr by the year 2000.

Although augmentation and conservation alternatives can potentially supply large quantities of water, many of the specific alternatives are likely to produce unacceptable consequences to many stakeholders. Several alternatives will produce substantial environmental costs and risks. This is more likely to be the case for augmentation, particularly for transfers (interbasin and intrabasin), impoundments, phreatophyte removal, and upland vegetation management. In contrast, environmental benefits, largely associated with preserving instream flows, are derived from most conservation alternatives.

If used extensively, augmentation and conservation would also result in economic costs. In fact, because of their economic costs, many alternatives would appear to require federal

TABLE 4-10: SUMMARY AND COMPARISON OF WATER AVAILABILITY ALTERNATIVES

CRITERIA	MEASURES	AUGMENTATION	CONSERVATION
Effectiveness How much water can be saved or added?	Acre-feet per year	Millions of acre-feet per year can be added regionally and to specific locations by augmentation alternatives.	Less water can be saved than can be added by augmentation, and more uncertainty is associated with the effectiveness of most conservation options.
	Long term or short term	Interbasin transfers, weather modification, and vegetation management can provide long-term supplies. Groundwater mining is an effective short-term option.	Conservation for energy resource development can alleviate large percentages of new water demands projected for the next 20 to 25 years.
Efficiency What are the costs, risks, and benefits?	Dollar cost per acre-foot	Capital-intensive projects cost up to $200 per acre-foot of water (interbasin transfers). Weather modification ($2 to $3 per acre-foot) and upland vegetation management ($20 per acre-foot or less in most areas) are relatively inexpensive.	Costs of agricultural conservation will generally be much higher than the value of the water saved ($25 per acre-foot). Water-saving cooling technologies can be economical or, at worst, represent small percentage increases in the cost of the energy product, except for electric power generation.
	Environmental costs and risks	Nearly every option has environmental costs and risks, but especially for water transfers, phreatophyte removal, and upland vegetation management. Risks of ecological damage from weather modification are uncertain.	Environmental effects are generally beneficial since surface flows will be increased. However, some wetlands will be threatened by agricultural conservation.
Equity How will costs, risks and benefits be distributed?	Who will pay?	Taxpayers and energy product consumers will ultimately pay most of costs for capital-intensive projects.	Agriculture in most cases will be unable to afford the costs and risks of conservation.
	Distribution among states and regions	Potential for inequities for donor basins and subbasins if transfers are used. Perceptions of inequitable distribution of water resources among basins of Colorado River will increase.	Increased conflict between West and other regions can be anticipated as other regions pay higher energy prices and taxes and as West's water resources are used for energy needs of other regions.

TABLE 4-10: (Continued)

CRITERIA	MEASURES	AUGMENTATION	CONSERVATION
Flexibility Can the alternatives be applied under different conditions and at different times?	Reversibility	Several options are inflexible because of long-term commitments of financial investments. Commitments to weather modification can easily be reversed, but impacts may be long term.	Most conservation options require long-term commitments either because of financial investments or the need for new technologies or equipment.
	Applicability	Except for upland vegetation management and weather modification, augmentation alternatives are applicable only in specific locations.	If alternatives are implemented by uniform regulations, flexibility to deal with locational circumstances will be sacrificed. Most alternatives can be applied region-wide.
Implementability How difficult will it be to enact and implement?	Institutional constraints	Transfers face severe legal and institutional constraints. Groundwater laws in some states will constrain groundwater storage and mining. Legal uncertainties may constrain weather modification.	Comprehensive changes in institutional and regulatory structures will be required, particularly state appropriation systems.
	Acceptability	Except for groundwater storage most alternatives already have generated strong opposition for environmental groups.	Agricultural interests and most western states will oppose changes in current water management practices.

subsidies. This is especially true for transfers, impoundments, underground storage, and conservation for irrigated agriculture, largely because of construction costs. The most effective conservation option, minimum wet cooling for energy facilities, appears to be economically infeasible. However, this alternative could still be used to save large quantities of water if costs were passed on to the consumer.

Economic and environmental risks contribute to several political problems for several alternatives. For example, interbasin and intrabasin transfers could create inequities for the donor basins or subbasins. In fact, perception of such inequities have already created legal barriers to interbasin transfers from the Columbia River system and generated conflict between west and east slope interests in Colorado. Equity problems may be less severe for conservative alternatives, except for irrigated agriculture which in general could not afford the capital costs of more efficient mechanical irrigation systems. Because irrigated agriculture is already heavily subsidized, further government support may not be feasible.

Political questions are also likely to arise over the flexibility of many of these alternatives. Because water availability problems depend on many locational variables, and because of western states' demands for control over their own growth, whether alternatives can be implemented and administered flexibly, reversed, and account for western values is likely to be an important evaluative criterion. However, flexibility may not be reconcilable with equity, to the extent that policymakers opt for alternatives which apply uniform standards or attempt to distribute costs, risks, and benefits equitably among states and sectors of society. This suggests that the more flexible alternatives, such as weather modification, may be more highly valued and that implémentation strategies should provide as much flexibility as possible. For example, intermediate wet cooling might best be implemented for imposing location-dependent ceilings on water use rather than requiring a uniform technology.

This evaluation does not lead automatically to the identification of one category of alternatives over another. This is in part because of a lack of adequate information and resource limitations. However, it is also because of the nature of water availability problems and issues, which incorporate a wide range of interests and values and critically affect growth and development on a region-wide basis. It is not at all clear that the regulatory system as currently constructed is capable of addressing these complex issues in a comprehensive and timely manner, other than by letting events and ad hoc, incremental decisions shape policy. This approach will almost certainly deprive some interests and values, particularly those of irrigated agriculture if economic considerations dominate.

Two overall conclusions stand out from this analysis. First, if policymakers choose to meet future water needs, a mix of policy alternatives will need to be used. While augmentation can apparently add more water than can be saved by conservation, augmentation will generate greater economic, environmental, and political costs and risks. Thus, balancing the need to meet water demands with these economic, environmental, and political considerations will require more rational and comprehensive approaches which consider a mix of alternatives. This analysis suggests that weather modification, intermediate wet cooling technologies for energy conversion facilities, groundwater storage, and selective vegetation management can add or save substantial quantities of water while minimizing overall consequences. Second, in order to be successful, policymakers will need to pay careful consideration to implementation strategies. The effectiveness of any choice can obviously be determined by how it is implemented. More generally, implementation strategies will need to allow flexible responses to local conditions, and to facilitate broad participation by local, state, and regional interests in the formulation, as well as the implementation, of new programs and policies.

CHAPTER 5

WATER QUALITY

EXECUTIVE SUMMARY

Water quality is closely related to water availability and will become an increasing concern as energy resources are developed in the eight state study area. Energy resource development is likely to heighten water quality concerns in two general ways. First, conversion of energy resources within the region will require large quantities of water, which, in conjunction with increased demands from other water users, can degrade water quality by concentrating pollution. Secondly, water quality can be affected more directly as a consequence of effluents released from energy resource developments and wastewaters from municipalities whose populations are likely to increase dramatically due to construction and operation of energy facilities.

Impacts

Our impact analysis of energy facility effluents has found that:

- More effluents are produced from TOSCO II and modified *in situ* oil shale production than from any coal conversion technology. TOSCO II oil shale production can produce over 16 million short tons of solid effluents per year. On a per unit of energy produced basis, this is over four times the amount produced by coal conversion technologies (Figure 5ES-1).

- Electric power generation valued on a British thermal unit-thermal basis produces less effluents than any other coal conversion process (Figure 5ES-1).

- Coal conversion processes can accumulate from about 1.5 million (Lurgi) to 3.5 million (Synthoil) tons of solid effluents per plant in on-site holding ponds over a 25 year period. These effluents contain heavy metals, trace elements, and other toxic pollutants which can create serious water quality problems if effluents are accidentally released from ponds.

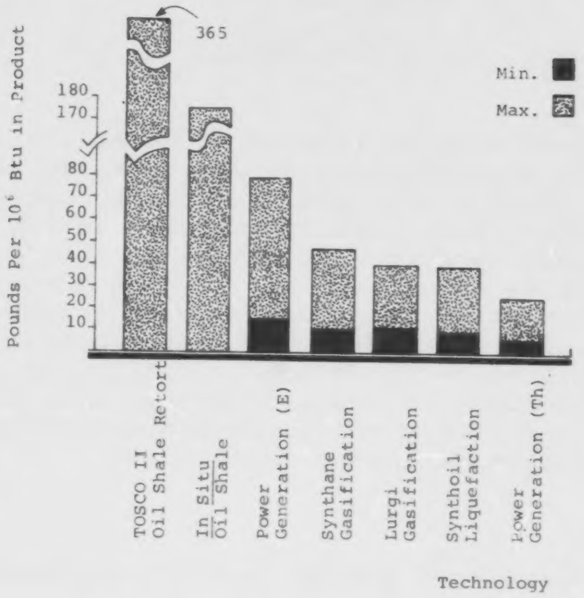

Figure 5ES-1: Effluents From Technologies

- Labor requirements of energy facilities may contribute to water quality problems because corresponding population increases will impose extreme demands on wastewater treatment facilities. Sewage treatment plants are likely to be quickly overloaded by these population increases.

- Energy resource development could require as much as 1.2 million acre-feet of water per year in the Upper Colorado River Basin (UCRB) by the year 2000. If most of these water requirements are taken from surface waters, salinity control problems, which are already serious, will be magnified because of the concentration effect of withdrawals.

The Policy Context

The federal government has assumed increasing responsibility for water quality control. The Federal Water Pollution Control Act (FWPCA) Amendments of 1972 and the Clean Water Act (CWA) of 1977 have set goals of: water clean enough for boating and fishing by 1978; water clean enough for swimming by 1984; and zero discharge of pollutants into navigable water by 1985. To achieve these goals, the Environmental Protection Agency has established programs to control effluents from both point sources, including energy facilities, and nonpoint sources, such as runoff and seepage of pollutants to surface water and groundwater from farming, mining, sanitation, and other sources.

It has been estimated that about 85 percent of industrial pollutants have been eliminated from surface waters since 1972. However, the remaining pollutants appear the most problematical and expensive to eliminate, and control of municipal pollution has been harder to achieve than control of industrial pollution. Control of nonpoint sources is impeded because they are generally extremely difficult to quantify. And, even though the federal government continues to legislate in this area, conflicts over the adequacy of current water quality regulations continue (see box).

The most serious water quality conflicts likely to be associated with western energy resource development appear to be:

- Pollution from holding ponds: Effluents discharged to on-site evaporative holding ponds can pollute surface water and groundwater and constitute a waste disposal problem after an energy facility has been shut down. Current federal and state regulations appear inadequate to deal with these potential problems.
- Municipal wastewater treatment: Inadequate treatment is already a problem in many areas, resulting in pollution of surface water and groundwater, community health problems, and restricted municipal growth. Few communities impacted by

> CLEAN WATER COMPROMISE
> VIEWS DIFFER
>
> Environmentalists have charged that the 1977 CWA will slow the pace of water pollution clean-up. A spokesman for the Clean Water Action project said the changes were a step backward. Especially troublesome to some environmentalists were delays in requiring industry to install pollution control equipment and permit exemptions for discharge of dredge or fill-in projects specifically authorized by Congress. Industry spokesmen, concerned over the cost of pollution control equipment, called the bill a reasonable compromise.
>
> --Denver Post, November 12, 1977.

energy resource development will be able to afford the costs of upgrading capacities to meet new demands or installing secondary and tertiary treatment required by the FWPCA and CWA. (See Chapter 9, Growth Management, for an elaboration of this issue.)

- Control of salinity: Substantial agricultural, environmental, industrial, and municipal damage is already caused by salinity. Salinity control is likely to contribute to strained intergovernmental relations related to water quality issues, particularly among states of the Colorado River Basin.

- Economic costs: Prices for energy products will almost certainly increase because of the need for improved effluent control and holding pond design and maintenance. Costs of agricultural products may also increase because of the need to improve irrigation efficiencies to reduce runoff, particularly if reduction of irrigation runoff is used to offset salinity concentrations due to energy development in a river basin.

Alternative Policies

Two general policy objectives are considered to deal with water quality problems: (1) allow western energy resource development while meeting the goals of current water quality laws and regulations, and (2) revise water quality goals and requirements. Table 5ES-1 identifies general and specific alternative policies for meeting these objectives.

If policymakers choose the first objective, to develop energy resources and meet current water quality goals, two categories of alternatives have been identified:

- Improve the effectiveness of controls on pollution sources;

- Treat surface water flows to reduce salinity and dissolved solids.

For each of these general categories, several specific alternatives can be employed. To improve the effectiveness of current water quality controls, policymakers can choose to control effluents from energy facilities, from municipal wastewater, and from nonpoint sources. If policymakers choose to emphasize surface water treatment, specific alternatives include desalination plants, containing flows of poor quality, diverting flows to avoid areas of high salt pick-up, and evaporation salt removal.

If policymakers choose the second objective of revising water quality goals and requirements, categories of alternatives include:

TABLE 5ES-1: WATER QUALITY ALTERNATIVES

POLICY OBJECTIVE	CATEGORY OF ALTERNATIVE	SPECIFIC ALTERNATIVE
Allow energy resource development and current water quality goals	Improve effectiveness of controls on pollution sources	Improve control of effluents from energy conversion facilities · improve design and maintenance of holding ponds · treat effluents before discharge to ponds · select energy conversion facilities which minimize water quality problems Improve control of municipal wastewater · provide necessary funds for western towns to employ comprehensive secondary or tertiary treatment · improve technologies for land applications of municipal sewage Improve control of nonpoint pollution · reduce runoff from energy facilities · reduce agricultural sources by controlling runoff, switching crops, improving conveyance systems, and removing marginal lands from production · control erosion and sedimentation
	Treat surface water	Desalination Flow diversion or containment Salt removal by evaporation
Revise water quality goals and requirements	Revise zero discharge goals	Apply discharge requirements to locational circumstances Delay timetable for achieving goals Require best practical technology but not best available technology
	Develop alternatives to secondary treatment	Reuse municipal wastewater Allow locational or situational variances

- Revise "ZERO discharge" goals;
- Develop alternatives to secondary treatment of municipal wastewater.

Some goals of the 1972 FWPCA were recently extended by the CWA of 1977 (see Section 5.2.2 A). In addition to delaying the timetable for achieving goals, alternatives include applying discharge requirements to specific locational circumstances such as local water quality conditions instead of uniform application, and requiring "best practical" rather than "best available" control technologies. Alternatives to secondary treatment include reusing municipal wastewater, for example as cooling water in energy facilities, and allowing locational or situational variances depending on the extent of existing water quality problems or capacity of existing treatment facilities.

Findings

This paper evaluates the extent to which improved control of pollution sources and treatment of surface waters can control salinity and biochemical oxygen demand (BOD) build-up, and reduce the potential of acute contamination of water resources from toxic substances released from holding ponds. Assessment of the specific alternatives identified in Table 5ES-1 indicates that:

- Considerable uncertainty is associated with estimating the effectiveness of improved holding pond design to reduce the risks of acute contamination of surface water and groundwater. However, it is clear that these ponds generally contain toxic pollutants and that considerable improvement can be made in their safety by improving their design and requiring pond liners.
- The most effective alternatives for controlling salinity appear to be desalination, which could remove up to 600,000 tons of salt per year per plant on the Colorado River, and reducing runoff from irrigated agriculture, which apparently can reduce salinity by 700,000 to 1,000,000 tons per year in the UCRB.
- Although desalination plants are very capital and energy intensive, they appear to be one of the more efficient options with respect to cost (less than $70 per ton removed) and reliability. Most alternatives for controlling agricultural runoff and erosion (improved irrigation efficiency, lining distribution canals, and producing water efficient crops) also cost less than $70 per ton, except improved irrigation efficiency which costs about four times as much.
- Control of pollution from municipal sources is considerably less effective, in terms of both total BOD removed and cost per ton, than control of agricultural sources and desalination.
- Several water quality control alternatives will be difficult to enact and implement because of the large capital investments required. This is particularly so for municipal waste treatment, desalination, stream flow diversion, and irrigation efficiency improvements. Each of these alternatives can contribute to increased public expenditures, require long-term and generally irreversible financial commitments, and may not be broadly applicable across the western states or to the specific water quality problems associated with individual energy facilities.

Conclusion

This evaluation reinforces the commonly held notion that water quality considerations cannot be separated from those of water availability. There appears to be little evidence to suggest that any single alternative or category of alternatives considered in this analysis would, by itself, be a successful response to water quality concerns. Particularly if scarce water resources of the West are continually depleted, none of the alternatives considered here may be useful in preserving water quality.

Policymakers can choose to trade-off one set of problems for another. For example, choosing to limit agricultural production in many areas of the West in favor of energy resource development could reduce salinity problems, but increase risks of potentially serious toxic pollution from industrial effluents. Regardless of which kind of economic development is encouraged or discouraged and which policy alternatives are chosen, this evaluation suggests that some of the same kinds of problems can be anticipated. These include increasing public expenditures for water quality control and increasing conflict among potential water users, among states of various water basins, and between the West and other regions.

CHAPTER 5

WATER QUALITY

5.1 INTRODUCTION

Energy resource development in the eight-state study area will produce water quality problems. The most serious of these are likely to occur as a consequence of the widespread use of evaporative holding ponds to dispose of water effluents, increased salinity caused by water withdrawals for energy development, and inadequately treated municipal wastewater.

Water quality has been a long-term concern in the West. Traditionally, this has largely but not entirely been a result of pollution from agricultural runoff and from natural sources. However, these concerns have recently intensified, in part because water quality is closely related to water availability. As more streams are overallocated and stream flows reduced, water quality is also reduced because pollutants are concentrated. Increased concern over water quality can also be traced to increased demands for water for energy, environmental, and water users. For example, environmental interest groups have actively opposed many water construction projects because of the potential water quality effects. And these and more recent concerns over water quality have increased intergovernmental conflict as well as conflict among potential users. For example, intergovernmental disputes have recently arisen between the federal government (Environmental Protection Agency [EPA]) and the states, among various states in the region, and among various governmental units within states.

Energy resource development in the West is likely to increase water quality concerns in two ways. First, conversion of energy resources within the region will require large quantities of water and can affect water quality both locally and in an entire river basin, especially in the Upper Colorado River Basin. Second, water quality can be affected more directly as a consequence of effluents released from energy developments and wastewaters from municipalities whose populations have greatly increased as a consequence of energy resource development. This chapter identifies and describes the water quality impacts which are likely to occur as a consequence of energy resource development (Section 5.2.1) and relates them to the existing social and political context within which they will occur (Section 5.2.2). Policy alternatives and implementation strategies for addressing potential problems and issues are then identified, evaluated, and compared (Section 5.3).

5.2 WATER QUALITY PROBLEMS AND ISSUES

5.2.1 The Water Quality Impacts of Energy Resource Development

As indicated in Section 4.2.1, both surface and groundwater are likely to be affected by energy resource development. In the Upper Missouri Basin, especially the Yellowstone, Belle Fourche, and Little Missouri, tributaries will be affected by energy development in Montana, Wyoming, and North Dakota. Upper Colorado tributaries, especially the San Juan, will be affected by developments in Colorado, Utah, and New Mexico.

Groundwaters in both the Upper Colorado and Upper Missouri basins may be contaminated from energy facility effluents and solid waste disposal, and aquifers may be disrupted by mining. The Madison aquifer and several shallow aquifers in the Fort Union Coal Formation (Wyoming, Montana, and North Dakota) may be affected by energy development in the Upper Missouri River Basin.

Impact analysis results reported in our Energy From the West: Progress Report[1] were designed to identify the potential impacts of energy on water quality. The analysis identified two kinds of factors, technological and locational, which can contribute to surface water and groundwater pollution. Technological factors include the quantities and composition of liquid effluents produced by conversion facilities, disposal technique, labor intensity of the facilities, and type of mining employed. Locational factors include the present quality of water resources in an area, soil permeability and aquifer depth, and community size and capacity of existing waste treatment facilities.

The most significant of these factors appears to be the quantity of effluent produced by the conversion facility. Figure 5-1 shows quantities of effluents produced by six conversion technologies. Effluents from TOSCO II oil shale retorting are the largest, most of which is spent shale in the form of wet-solid.[2]

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[1] White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977. Final impact analysis results are reported in White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[2] The spent shale is moisturized to approximately 14 percent moisture and transported by conveyor belt for disposal. This helps control dust and appears to lead to cementation of the shale after proper compaction which reduces leaching.

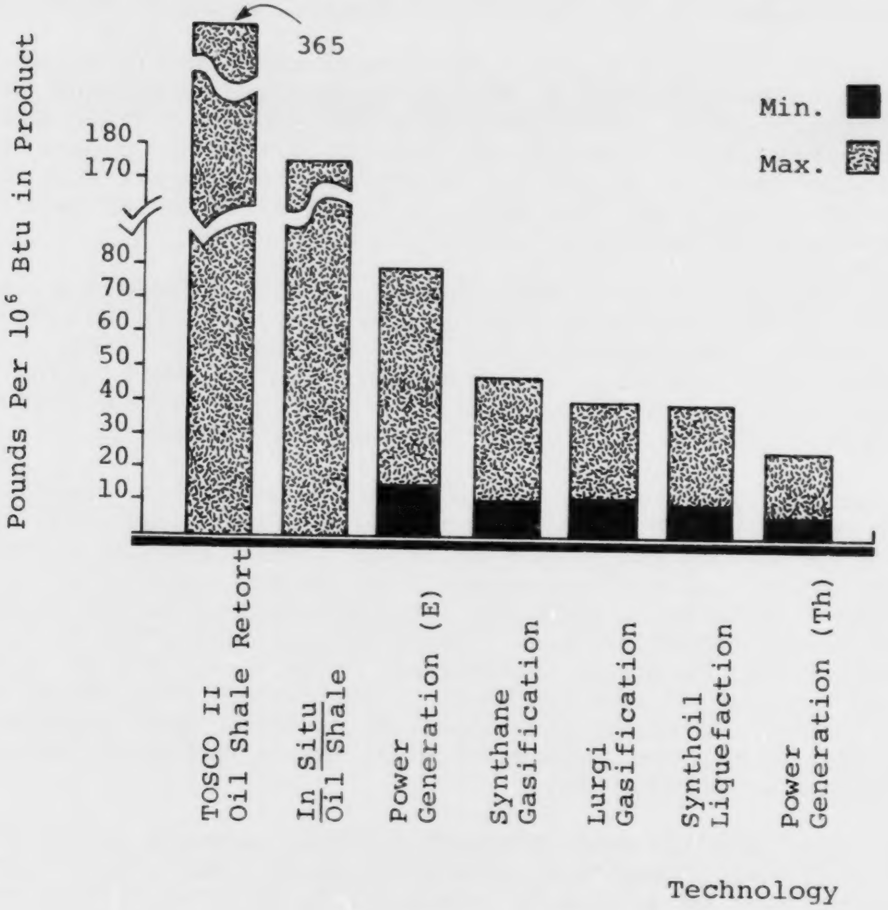

FIGURE 5-1: EFFLUENTS FROM TECHNOLOGIES

Btu = British thermal unit
E = electric
Th = thermal

Electric power generation compared on a British thermal unit (Btu)-electric basis generates more effluents than any synfuel facility except TOSCO II and in situ oil shale.

Because the Federal Water Pollution Control Act (FWPCA)[1] limits the direct discharge of industrial wastewater pollutants into surface water, water quality problems from effluent disposal are not as likely to arise from direct discharge as from indirect runoff. This runoff can drain directly into surface water and seep into groundwater. Runoff from spent shale and water leaching through the shale are potential water quality problems, particularly from spent shale dumped into ravines. Total quantities can be large (110,000 tons of wet-dry solids per day), and thus the potential for contamination is great.[2]

Effluent treatment practices at coal conversion facilities may also degrade water quality. The results of our impact analyses suggest that the discharge of effluents into on-site holding ponds can cause surface and groundwater pollution.[3] Potentially significant problems can arise because of the accumulation of trace quantities of toxic elements and heavy metals found in fly ash, lime, and limestone from the scrubbers. Total quantities of solids discharged to the ponds can be quite large--ranging from about 13 million to 100 million tons accumulated over 25 years depending on the type of facility. If accumulations of wet-solids containing heavy metals and/or trace elements are released as a consequence of local flooding or berm failure, they could produce acute effects in local surface waters. In addition to berm failures, seepage from holding ponds can contaminate groundwater aquifers, which in turn, may introduce pollutants into wells or local streams. The extent of this problem depends in part on whether ponds are lined and the kind of liner used. Some state guidelines now call for the use of lined disposal ponds.

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[1] Federal Water Pollution Control Act Amendments of 1972, Pub. L. 92-500, 86 Stat. 816. The 1977 amendments to this act are titled Clean Water Act of 1977, Pub. L. 95-217, 91 Stat. 1566.

[2] These estimates are for TOSCO II oil shale retorting (100,000 barrels per day). TOSCO officials believe that this is not a problem. They maintain that the spent shale will be compacted and be impermeable, thereby virtually eliminating any leaching.

[3] It should be noted that the use of on-site holding ponds is partially an economic decision; it is often cheaper to treat and recycle the water as long as possible and discharge effluents into ponds rather than to discharge treated effluents into navigable waters. However, holding ponds are also a common response to requirements and guidelines of the FWPCA.

Labor requirements of energy development technologies may also contribute to water quality problems since the magnitude of the population increases which occur will be directly related to the size of the workforce. This increased population will impose demands on wastewater treatment facilities. Our impact analysis results suggest that sewage treatment plants are likely to be quickly overloaded by energy-related population increases.

Although the quantities of population-related effluents are much less than those associated with energy facilities, several policy problems and issues are likely to arise as a result of large population increases in small western towns. First, poorly treated effluents can cause degradation of surface waters. Second, many communities will be unable to afford the costs of either upgrading capacities to meet new demands or of installing secondary treatment required by the FWPCA by 1978. In cases in which the need for sewage treatment is higher during the construction phase of a facility than during its operation, as it is for gasification and power plant facilities, it may be impractical to build sewage treatment plants to serve short-term peak demands only to have them underutilized later.[1] Third, insufficient sewer systems may affect other local problems and issues; for example, new housing may be delayed and community health standards may be violated.

5.2.2 The Context of Water Quality Issues in the West

As suggested above, problems and issues related to water quality are closely tied to those of water availability and, thus, many of the interests at stake in water quality control are the same as or related to those discussed in Chapter 4. In the private sector, values promoted by environmental interest groups often conflict with those championed by energy industries and agricultural interests. For example there are already conflicts over controlling the discharge of pollutants and the impact of different water uses on water quality.

In the public sector, many of the anticipated water quality impacts of energy development will be regulated both by the states and federal government. Although the federal government, especially EPA, has taken the lead in this area, intergovernmental relations have already been strained by the federal-state "partnership" requirements of the FWPCA, by conflicts over salinity control, and by disputes related to channeling federal funds for wastewater treatment to the states.

The current status of water quality control is mixed. On the one hand, since passage of the FWPCA of 1972, water quality control has greatly reduced the discharge of industrial pollutants into surface water. On the other hand, remaining pollutants appear the most difficult and expensive to eliminate; and the control of municipal pollution has been a relative failure compared to control of industrial pollution.[1] Further, as knowledge increases, it becomes increasingly clear that water quality control is intricately tied to water supply and use.

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[1] This problem is discussed in Chapter 9, Growth Management.

A. Historical Development

Although the federal government has been active in water pollution control since 1899,[2] it is the FWPCA of 1956, as amended in 1961, 1965, 1966, 1970, 1972, and 1977, that is the legal backbone for clean water, providing for construction and other grants, standards, enforcement procedures, and research programs. The FWPCA of 1956 is significant because it began the trend of increasing federal control of water pollution. The Amendments of 1961, 1965, 1966, and 1970 incrementally expanded the federal role, although leaving primary responsibility to the states, and also expanded federal financial support for pollution control.

Corresponding to the environmental movement in general, pressures increased in the late 1960's and early 1970's for strong federal involvement in water pollution control. This was largely because of perceptions that water quality was getting worse instead of better[3] and, correspondingly, that states were not doing an adequate job of pollution control. Hence, after two year's work and an override of a presidential veto, Congress passed a fundamentally different FWPCA in 1972. Even though states were given administrative and implementation responsibilities, water pollution control became largely a federal responsibility. Nationwide effluent standards are set by EPA; and EPA has to approve state implementation programs--and can disapprove individual permits.[4]

As articulated in the FWPCA of 1972, the federal government's water quality program goals are: water clean enough for boating and fishing by 1977; water clean enough for swimming by 1983; and zero discharge of pollutants into navigable water by 1985. Midcourse corrections to the FWPCA passed in late 1977 extend the 1977 and 1983 deadlines by one year and make adjustments in standards and permitting procedures which are discussed below.[1] Although the proposed amendments are the result of over two years of bargaining and compromise, they have produced varied reactions from interested parties (see box).

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[1] For example, in 1976 EPA estimated that 85 percent of all major industries, but only about 30 percent of the nation's cities and towns would meet 1977 goals for initial water quality improvements. See U.S., Council on Environmental Quality. Environmental Quality, Eighth Annual Report. Washington, D.C.: Government Printing Office, 1977.

[2] For example, the Rivers and Harbors Act of 1899, 30 Stat. 1121.

[3] The third annual report of the Council on Environmental Quality suggested that a higher percentage of surface waters were polluted in 1971 than in 1970. See U.S., Council on Environmental Quality. Environmental Quality, Third Annual Report. Washington, D.C.: Government Printing Office, 1972, pp. 11-15.

[4] Federal Water Pollution Control Act Amendments of 1972, Pub. L. 92-500, 86 Stat. 816, 33 U.S.C.A. §§ 1251 et seq. (Supp. 1976.)

B. Current Programs and Conflicts

(1) Point Sources

The program to regulate point sources is known as the National Pollutant Discharge Elimination System (NPDES). Under this program, no effluent can be discharged by a point source (such as municipal and industrial discharges, including energy facilities) without a permit which sets the conditions under which the discharge may be made. These conditions include ensuring that all requirements of FWPCA are met. Permits are issued by EPA or the state, if the state program has been approved by EPA.[2] However, as noted above, even when EPA has approved a state program, it still retains control since it can veto any individual permit proposal and withdraw its approval of a state's entire permit program.

> CLEAN WATER COMPROMISE
> VIEWS DIFFER
>
> Environmentalists have charged that the 1977 FWPCA Amendments will slow the pace of water pollution clean-up. Larry Silverman of the Clean Water Action project said the changes were a step backward. Especially troublesome to some environmentalists were delays in requiring industry to install pollution control equipment and permit exemptions for discharge of dredge or fill in projects specifically authorized by Congress. Industry spokesmen, concerned over the cost of pollution control equipment, called the bill a reasonable compromise.
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> --Denver Post, November 12, 1977.

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[1] Clean Water Act of 1977, Pub. L. 95-217, 91 Stat. 1566.

[2] To be approved by EPA, a state's laws must authorize the state to: issue permits that apply all FWPCA requirements; monitor permittees to the extent required by the FWPCA; notify the public when an application is made and provide an opportunity for a public hearing; give EPA, downstream states that would be affected, and the Corps of Engineers an opportunity to object; and impose requirements on publicly owned treatment facilities. See Dolgin, Erica L., and Thomas G.P. Guilbert, eds. Federal Environmental Law. St. Paul, Minn.: West, 1974, p. 735. Four of the eight states in our study area have EPA approved programs: Colorado, Montana, North Dakota, and Wyoming. The regional EPA office issues permits in those states that do not have EPA approved permit programs.

The Clean Water Act (CWA) of 1977 divide point sources into three categories: conventional, such as sewage and dirt; nonconventional, such as pesticides and heavy metals whose toxicity is yet to be determined; and toxic, for which EPA has a tenative list of 129 chemicals (see Table 5-1). This revision has drawn criticism from environmentalists who are concerned that some dangerous chemicals may stay on the unconventional list indefinitely, but it has been supported in EPA because increased discretion has been given to the EPA administrator to designate toxic substances.[1]

In working toward the 1985 goal of zero discharge of pollutants into navigable waters, the 1972 Act established two interim levels of effluent standards: by July 1, 1977, all point source discharges except publicly owned treatment works were required to meet an effluent level defined by the "best practicable control technology currently available"; and by July 1, 1983, these discharges must meet a level defined by the "best available technology economically achievable."[2] The reference point for the 1983 levels for point sources is the 1985 goal of zero discharge.[3] Both the 1977 and 1983 technology-based standards are defined when EPA issues discharge permits and establishes effluent standards for each category of discharge. As noted above, both deadlines were extended one year by the 1977 Amendments.

As shown in Table 5-1, the FWPCA also requires the EPA administrator to set effluent standards for new point sources to provide:

> ...the greatest degree of effluent reduction... achievable through application of the best demonstrated control technology, processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge of pollutants.[4]

Subsequent to these standards being established, they must be met by all new point sources in each category. Point sources that

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[1] "Water Act Revision Complete." Science, Vol. 198 (December 16, 1977), p. 1130.

[2] By 1977, publicly owned treatment works were required to meet levels achievable using "secondary treatment," and by 1983, the "best practicable waste treatment technology over the life of the works."

[3] Dolgin, Erica L., and Thomas G.P. Guilbert, eds. Federal Environmental Law. St. Paul, Minn.: West, 1974, p. 695.

[4] Federal Water Pollution Control Act Amendments of 1972, § 306, 33 U.S.C.A. § 1316 (Supp. 1976).

TABLE 5-1: CURRENT FEDERAL EFFLUENT REGULATIONS[a]

TYPE OF FACILITY OR POLLUTANT	TREATMENT REQUIRED
Industrial	"best practicable control technology currently available" as defined by the EPA administrator by July 1, 1978.[b] "best available technology economically achievable" as determined by the EPA administrator by July 1, 1984.[b] Limits are based on categories or classes of industries. national performance standards--including zero-discharge, if practicable--for each new category of source.
Municipal	effluent limitations based on secondary treatment by July 1, 1978.[b] best practicable technology over the life of the works by July 1, 1984.[b]
Toxic pollutants (seriously harmful to human or other life)	effluent limitations including prohibition of discharge, if needed, to provide "an ample margin of safety" set by the EPA administrator.
Radiological, chemical, or biological warfare agents or high-level radioactive waste	discharge prohibited
Thermal discharge	effluent limitations set to ensure a balanced population of fish, shellfish, and wildlife.
Oil or hazardous substances	no discharge into U.S. waters, adjoining shorelines or contiguous zone waters.

EPA = Environmental Protection Agency

[a] Federal Water Pollution Control Act Amendments of 1972, Pub. L. 92-500, 86 Stat. 816. Adapted from Congressional Quarterly, Inc. *Congress and the Nation, Vol. III: 1969-1972*. Washington, D.C.: Congressional Quarterly, p. 797.

[b] Data here reflects the change in the law made by the Clean Water Act of 1977, Pub. L. 95-217, 91. Stat. 1566.

existed prior to the establishment of new source standards in their categories must meet the conditions contained in their discharge permit, including a compliance schedule to bring effluent limitations to the specified states. New source standards have been established for the 27 major industrial categories listed in the FWPCA as well as a number of others. Those categories affecting western energy resource development include: coal mining, ore mining and dressing (uranium), steam electric power plants, and petroleum refining.

The FWPCA also requires the Administrator of EPA to set effluent standards for toxic pollutants.[1] These standards are to provide for "ample safety" and can prohibit the discharge of a toxic pollutant altogether. Several pesticides, benzidene, and polychlorinated biphenyls were subsequently designated as toxic pollutants and standards established regulating their discharge. In 1976 Congress enacted the Toxic Substances Control Act,[2] thereby placing greater emphasis on the control of such substances and greatly expanding EPA's responsibility for identifying and controlling them. And meeting this responsibility is receiving a high priority at EPA.

Effluent standards also apply to thermal discharges. However, if the point source discharger can show that the limitation on the thermal component of his discharge is "more stringent than necessary to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is made," EPA or the state issuing the discharge permit may make an exception for the thermal component.[3]

Prior to 1972, the major federal water quality program required the states to adopt water quality standards that met the approval of the Secretary of the Interior (the Administrator of EPA after EPA was created).[4] Under the FWPCA, existing water

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[1] Toxic pollutants are defined to include any pollutant that is toxic to any organism and that might cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions, or physical deformations.

[2] Toxic Substances Control Act of 1976, Pub. L. 94-469, 90 Stat. 2003 (to be codified at 15 U.S.C.A. §§ 2601 _et seq._) (1976).

[3] Dolgin, Erica L., and Thomas G.P. Guilbert, eds. _Federal Environmental Law_. St. Paul, Minn.: West, 1974, p. 712. The authority to make this exception is explicitly stated in the statute (Section 307).

[4] Water Quality Act of 1965, Pub. L. 89-234, 79 Stat. 903.

quality standards for interstate waters continue in effect, and new standards require federal approval. These standards are enforced under the FWPCA requirement that all dischargers meet the technology-based effluent standards discussed above or more stringent limitations if such limitations are necessary to implement water quality standards established under the FWPCA.[1] Streams or segments of streams can be designated as being either "effluent limited" or "water quality limited";[2] discharges into a "water quality limited" stream are subject to more stringent limitations.

All these point source requirements affect energy resource development in the western U.S. The effluent standard limitations have the effect of requiring discharges to be treated or cooled. For example, water used for processing and flue gas desulfurization would have to be treated and thermal discharges cooled. However, the costs of supplying water may make it more economical for the developer to continue to treat and recycle the water as long as possible and to discharge effluents into evaporative ponds rather than to discharge treated effluents into navigable waters. Wastes (including wastes from processing and flue gas desulfurization) will accumulate in these ponds and can create potentially significant surface water and groundwater quality problems. The policy point here is that the FWPCA requirements aimed at protecting surface water quality may contribute to the decision to use water and effluent disposal alternatives that can lead to other potentially serious water quality problems.[3] Specifically, the pollutants can be accidentally released into surface waters, leach into groundwater, and constitute a long-term waste accumulation problem after the energy development has been shut down.

One aspect of wastes being accumulated in evaporative ponds that may be particularly significant is the presence of trace materials. The quantities and types of trace materials that may accumulate in such ponds is not known, but even small concentrations of the more toxic materials such as lead and arsenic could produce acute effects and thus must be viewed as potentially significant problems. For example, 45 samples of effluents from in situ coal gasification in Wyoming, a low Btu coal gasification plant in Virginia, and an in situ oil shale gasification project in Colorado and Wyoming were analyzed for chemical elements and volatile organic compounds. More than 74 elements and 200 organic compounds were reported in some of the samples.[1] In effect, discharging such waste materials into evaporative ponds creates a potential nonpoint source of pollutants similar to some nonpoint sources discussed in the following section.

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[1] Federal Water Pollution Control Act Amendments of 1972, § 303, 33 U.S.C.A. § 1313 (Supp. 1976).

[2] U.S., Environmental Protection Agency. Clean Water. Report to Congress--1974. Washington, D.C.: Environmental Protection Agency, 1974, p.8.

[3] The material stated above about the role of economics in the decision to treat and recycle water and pond effluents should not be ignored. What we have found at this stage of our analysis is not that the FWPCA is the sole cause, but that it may be a contributing cause.

Such wastes may become regulated under the Resource Conservation and Recovery Act of 1976, the most general Congressional action directed towards the management of solid waste disposal. Its impact on energy development will be dependent on how the EPA decides to interpret one of the Act's main objectives: to provide for a nationwide system for the management of "hazardous" waste. If, for example, EPA uses the safe drinking water standards as the basis for the functional leachate test, it is likely that some solid waste from coal development will be declared hazardous (such a trend is already indicated by EPA's regulation of fly ash leachate as a polluting point source under FWPCA). Such a definition would have serious implications for solid waste disposal by the coal industry.

(2) Nonpoint Sources

The federal government's water quality program also deals with nonpoint sources such as those that result in "...runoff, seepage, and percolation of pollutants to surface waters and groundwaters through diffuse and undefined routes."[2] Irrigated and nonirrigated farming, mining, urban runoff, and rural sanitation are examples of nonpoint sources.

Recognition appears to be increasing that nonpoint sources are responsible for a substantial percentage of the nation's water quality problems and may account for as much as 50 percent of total water pollution.[3] This percentage may be higher in the western states because so much of the land is devoted to irrigated agriculture. These findings suggest that EPA may have to devote more attention to nonpoint sources, which have been secondary to point sources in regulation to date. The problem is worsened because nonpoint sources are extremely difficult to quantify and because nonpoint sources are extremely diverse in nature and location.[1]

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[1] Morgan, George B. "Energy Resource Development: The Monitoring Components." Environmental Science and Technology, Vol. 12, (January 1978), pp. 34-43.

[2] U.S., Environmental Protection Agency. Clean Water. Report to Congress--1974. Washington, D.C.: Environmental Protection Agency, 1974, p. 14.

[3] Miller, Gay. "Municipalities Trail Industry in Clean-Up of Water Pollution." Wall Street Journal, October 13, 1976.

Section 208 of the FWPCA establishes procedures under which states or regional agencies are required to establish nonpoint source regulatory programs.[2] These procedures require the governor of each state to designate areas within their states that have "substantial water quality problems"[3] and "a single representative organization including elected officials from local governments or their designees" as the 208 areawide planning agency. The designated planning agency is required to operate "a continuing areawide waste treatment management planning process."[4] EPA must approve the plans prepared by the designated planning agency.[5]

Areawide plans must address nonpoint source pollution problems that are related to: agriculture and silviculture; mining, including "new, current, and abandoned surface and underground mine runoff";[6] construction; and "salt water intrusion into rivers, lakes, and estuaries resulting from reduction of fresh water flow from any cause including irrigation, obstruction, groundwater extraction, and diversion."[7] Solid waste disposal problems that might affect surface or groundwater quality must also be addressed in these plans.

The report on the Colorado River Basin prepared for the National Commission on Water Quality by Utah State University's Utah Water Research Laboratory indicates that the salinity of the

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[1] For example, land runoff pollution may depend upon how long it has been since a previous rain, storm intensity and duration, air quality, and land use.

[2] See Chapter 9 for a discussion of the assistance aspects of the Section 208 program.

[3] Federal Water Pollution Control Act Amendments of 1972, § 208, 33 U.S.C.A. § 1288 (Supp. 1976).

[4] Ibid.

[5] Dolgin, Erica L., and Thomas G.P. Guilbert, eds. Federal Environmental Law. St. Paul, Minn.: West, 1974, p. 767.

[6] Federal Water Pollution Control Act Amendments of 1972, § 208(b)(2)(G), 33 U.S.C.A. § 1288(b)(2)(G) (Supp. 1976).

[7] Ibid., § 208(b)(2)(I), 33 U.S.C.A. § 1288(b)(2)(I) (Supp. 1976).

Colorado "generally increases from the headwaters to the mouth."[1] This salinity increase is attributed to salt loading (i.e., adding salts to the river) and salt concentrating (i.e., consuming water from the river). Both nature and people contribute to salinity through both processes. The Utah Water Research Laboratory estimates that about two-thirds of the salt loading in the Colorado is due to natural sources and about one-third to "man-manipulated sources."[2] That laboratory also estimates that approximately 84 percent of the salt loading comes from nonpoint sources and 16 percent from point sources such as mineral springs (6 percent) and "artificial drainage of irrigation return flows" (10 percent).[3]

Although water quality concerns about the Colorado River were expressed in federal legislation as early as 1956,[4] until the Water Quality Act of 1965[5] legislation generally did not establish standards but only provided for such things as studies of water quality, estimates of the effect of additional developments, and determination of the water's suitability for various uses. As noted above, the Water Quality Act required water quality standards to be established. This requirement led to a series of water pollution conferences to negotiate water quality for the Colorado River system.[6] At the Seventh Enforcement Conference convened by EPA in early 1972, the seven Colorado River Basin states agreed that salinity levels should be held at 1972 levels, that holding these levels should not prevent development in the Upper Basin, and that salinity control projects were preferable to salinity standards. During that same year, the FWPCA was enacted, authorizing EPA to impose numeric standards on the Colorado (and other rivers). In the following year, the U.S. entered into the agreement with Mexico,[7] the effect of which was to limit the salinity of Colorado River water flowing into Mexico. And in 1974, the Colorado River Salinity Control Act was enacted to provide funding for construction of a large desalting complex in the Lower Basin and four salinity control projects in the Upper Basin and to expedite planning for other salinity control projects.

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[1] Utah State University, Utah Water Research Laboratory. Colorado River Regional Assessment Study, Part I: Executive Summary, Basin Profile and Report Digest, for National Commission on Water Quality. Logan, Utah: Utah Water Research Laboratory, 1975, p. 2.

[2] Ibid.

[3] Ibid.

[4] See Ibid., pp. 97-98 for a description of this legislation.

[5] Water Quality Act of 1965, Pub. L. 89-234, 79 Stat. 903.

[6] Utah Water Research Laboratory. Colorado River Regional Assessment Study, Part I, p. 98.

[7] See Chapter 4.2 for a discussion of this agreement.

In December 1974, EPA, under the authority of Section 303 of the FWPCA, published a regulation requiring that the average salinity in the Lower Colorado River be maintained at or below the 1972 level. To achieve this objective, Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming were required to adopt and submit to EPA for approval water quality standards; identify state and federal regulatory authorities and programs necessary to achieve compliance; and treat salinity as a basinwide problem of maintaining Lower Colorado River salinity levels at or below 1972 averages as basin states continued to develop their compact-allocated waters. The EPA regulation stated that the goal of the plan should be to achieve compliance with the adopted standards by July 1, 1983.[1]

To meet these requirements, the seven Colorado River Basin states negotiated an agreement known as the "Proposed Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System, June 1975" and "Supplement" thereto dated August 26, 1975.[2] Together, these two documents constitute the water quality standards required by Section 303 of the FWPCA and EPA's December 1974 salinity control regulation.[3] By November 1975, the appropriate state agencies had adopted these two documents and had submitted them to EPA.

Although salinity standards have been agreed to, permit criteria have not been established, and the states and EPA have apparently been unable to agree on how the standards would be implemented. The plan has been criticized by environmentalists, and the Environmental Defense Fund has filed suit against EPA for failure to comply with FWPCA requirements for stream standards and development of an adequate control plan, including a compliance schedule (see box entitled, "EDF Sues for Salinity Control"). This lawsuit apparently has contributed to increased conflicts among Upper and Lower Basin states. Upper Basin states perceive that salinity standards may restrict utilization of their full entitlement of Colorado River Water.[1]

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[1] 41 Fed. Reg. 13,656-57 (March 31, 1976).

[2] The agreement was negotiated within the Colorado River Basin Salinity Control Forum, which was formed to respond to EPA's salinity control regulations.

[3] The numeric salinity standards are 723 milligrams per liter (mg/ℓ) below Hoover Dam, 747 mg/ℓ below Parker Dam, and 879 mg/ℓ below Imperial Dam. The plan provided for immediate construction of four desalting units, future construction of 12 others, placement of effluent limits on industrial discharges, and several other proposals or studies for identifying salinity control alternatives. See 41 Fed. Reg. 13,656-57 (March 31, 1976).

Although at present salinity problems in the Upper Missouri are not comparable to those encountered in the Colorado River Basin, energy resource development will generally voice the same problems and issues in the basin. However, these problems and issues may be dealt with differently by the states in the two basins since salinity is already a serious problem in the Colorado but not in the Upper Missouri. Of course, energy resource development within the entire area will be regulated and controlled by the states and federal government, and [illegible] point and nonpoint sources regulatory programs discussed above will generally apply.

EDF SUES FOR SALINITY CONTROL

The Environmental Defense Fund (EDF) is suing EPA to require stricter control in the Colorado River Basin. An EDF spokesman, calling salinity the most serious water quality problem in the basin, estimated the salinity cost for agricultural, municipal, and industrial users to be over $50 million annually. EDF will try to get EPA to enforce existing laws and force states to meet control deadlines. Another EDF spokesman called for the creation of a system of "salinity rights" that could be treated like current water rights in order to regulate the quality of water returned to surface waters.

--See: Gill, Douglas. "Man, Nature Share Blame for Colorado River's Salinity." Denver Post, April 24, 1977; and "EDF to Sue for Water Salinity Control." Denver Post, April 15, 1977.

As suggested in Section 5.2.1 above, water quality impacts of western energy resource development could include: runoff from mines, spoils piles, facilities, and urban areas; a contribution to the concentration of salts in surface waters due to the consumptive use of water; the accidental introduction of pollutants from evaporative ponds into surface waters; and the contamination of groundwaters, seeps, springs, and ponds.

As either point or nonpoint sources, energy resource development in general may not create as much of a salinity problem as would some other uses, particularly agricultural irrigation.[1] In general, the amount of water consumed (withdrawn and not returned) by such developments should not have as much of a salt-concentrating effect on area surface streams compared to water used for other purposes.[2] These two tentative conclusions are important politically, particularly for the Colorado River Basin states, because of the salinity problem that already exists there. For example, it may be in California's interest to have any increase in water consumption in the Upper Basin be for energy or other nonagricultural uses if such uses will create less of a salinity problem.

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[1] Mann, Dean E. "Water Planning in the Colorado River Basin States: Challenges and Prospects." Paper presented at the annual meeting of Western Political Science Association, Los Angeles, California, March 15-18, 1978, pp. 9-10.

However, suggesting that energy development will generally create less of a salinity problem does not solve all development-associated water quality problems and issues. Present salinity levels in the Colorado River Basin are so high that even the various kinds of runoff from development sites can become a problem particularly during construction. Also, the accidental release of pollutants from holding ponds cannot be ruled out at this stage in our analysis, nor can the possible contamination of groundwaters by pollutants leaching from evaporation ponds and seeping from septic tanks in rural areas be ignored.

5.2.3 Summary

Water quality is already an important concern in the eight-state study area, especially regarding salinity and sediment in the Colorado River Basin. Energy resource development will increase water quality concerns because of the potential for pollution from energy withdrawals of large quantities of this already-scarce resource. Specific water quality problems include:

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[1] See Holburt, M.S., and V.E. Valentine. "Present and Future Salinity of the Colorado River." Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol. 98 (March 1972), pp. 503-20. Of course, the relative impact of energy resource development and irrigated agriculture on salinity depends on both type of technology and locational circumstances.

[2] This does not eliminate the possibility of excessive salt concentrations occurring locally in some areas, especially under low flow conditions, and the basinwide effects must be examined in more detail than has been possible in this study. From the analysis of alternative futures, the Utah Water Research Laboratory concluded that taking water out of the river will have more of a salt-concentrating effect than will adding salts. This emphasizes how important water conservation and minimization techniques are likely to become. See Utah State University, Utah Water Research Laboratory. Colorado River Regional Assessment Study, Part I: Executive Summary, Basin Profile and Report Digest, for National Commission on Water Quality. Logan, Utah: Utah Water Research Laboratory, 1975.

- Control of effluents in on-site evaporative holding ponds which can pollute surface water and groundwater and constitute a waste-disposal problem after an energy facility has shut down. Current federal and state regulations appear inadequate to deal with these potential problems.
- Inadequate treatment of municipal wastewater, already a problem, can pollute surface water and groundwater, cause community health problems, and restrict municipal growth. Few communities impacted by energy resource development will be able to afford the costs of upgrading capacities to meet new demands or of installing secondary and tertiary treatment required by the FWPCA.
- Control of salinity, which already causes substantial agricultural, environmental, industrial, and municipal damage. Salinity control is likely to contribute to already-strained intergovernmental relations related to water quality issues, particularly among states of the Upper and Lower Colorado River Basin.
- The potential for increased economic costs for energy products because of the need for improved effluent control and holding pond design and maintenance, and/or increased costs for agricultural products because of the need to improve irrigation efficiencies to reduce runoff.

These problems and issues have already led to several political conflicts which are likely to increase as energy resource development makes increasing demands on water resources. The most critical of these conflicts may occur among the states of the Upper and Lower Colorado River Basin over the appropriate uses of Colorado River water in general and salinity control in particular. Intergovernmental conflicts are also likely to increase between the western states and EPA over control of salinity and of effluents from energy conversion facilities. Further, each of the water quality problems and issues identified are likely to exacerbate conflicts among environmental, industrial, and agricultural interests.

5.3 ALTERNATIVE POLICIES AND IMPLEMENTATION STRATEGIES FOR WATER QUALITY

5.3.1 Introduction

The discussion in the previous two sections makes it clear that policymakers are likely to have to deal with several water quality problems and issues as western energy resource development progresses. The basic question they must address is whether present water quality goals and large-scale energy resource development are compatible. In structuring their response, they can opt for one of two general policy objectives: (1) allow western energy resource development to go ahead while retaining current water quality laws and regulations; or (2) revise current water quality laws and regulations to accommodate western energy resource development. Table 5-2 identifies two categories and several specific policy alternatives which policymakers might choose to achieve these objectives.

If policymakers choose to attempt to develop energy resources while achieving current water quality goals, they can either:

- Improve the effectiveness of existing controls on water pollution sources; or

- Treat surface water flows to reduce salinity and dissolved solids.

To improve the effectiveness of current water quality controls, policymakers can choose to control effluents from energy resource facilities, from municipal wastewater, or from nonpoint sources. If policymakers choose to emphasize surface water treatment, specific alternatives include desalination plants, containing or diverting flows to avoid areas of salt pick-up, and salt removal by evaporation.

To revise water quality goals and requirements, policymakers can choose either to:

- Revise "zero discharge" goals; or

- Develop alternatives to secondary treatment of municipal wastewater.

In addition to delaying the timetable for achieving goals (as provided for in the CWA of 1977),[1] specific alternatives can include applying discharge requirements to particular locational circumstances such as local water quality conditions and requiring "best practicable" but not "best available" control

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[1] Clean Water Act of 1977, Pub. L. 95-217, 91 Stat. 1566.

TABLE 5-2: WATER QUALITY ALTERNATIVES

OBJECTIVE	CATEGORIES OF ALTERNATIVES	SPECIFIC ALTERNATIVE
Allow energy resource development and meet the goals of current water quality laws and regulations	Improve the effectiveness of the current water quality controls of pollution sources	Improve the control of effluents from energy conversion facilities: Improve the design and maintenance of holding ponds; Treat effluents before they are discharged into on-site holding ponds; Select energy conversion facilities which minimize water quality problems. Improve the control of municipal wastewater: Provide necessary funds for western towns to employ comprehensive secondary or tertiary treatment; Improve the technologies for land applications of municipal sewage. Improve the control of nonpoint pollution, including: Energy facility runoff; Agricultural practices, (including irrigation runoff, crop selection, conveyance systems, and removing marginal lands from production); Erosion and sedimentation.
	Treat surface waters	Desalination Contain or divert flows Salt removal by evaporation
Revise water quality goals and requirements	Revise "zero discharge" goals	Apply discharge requirements to specific locational circumstances Delay timetable for achieving goals Require best practicable technology but not best available technology
	Develop alternatives to secondary treatment	Reuse municipal wastewater Allow locational or situational variances

technologies. Alternatives to secondary treatment can include reusing municipal wastewater (for example as cooling water in energy facilities) and allowing locational or situational variances depending on the extent of existing water quality patterns or capacity of existing treatment facilities.[1]

In the remainder of this section, the policy alternatives identified above are discussed in more detail. First, two categories of alternatives are described and implementation strategies are identified (5.3.2). Then, alternatives for allowing energy resource development and meeting current water quality goals and requirements are evaluated (5.3.3) and compared (5.3.4).

5.3.2 Description of Alternatives and Implementation Strategies

A. Improved Control of Water Pollution Sources

Because increased development of energy resources may be one of the largest new sources of water pollution in the western states, improved control of effluents from energy facilities is likely to be particularly important. This appears to be especially true in the case of on-site evaporative holding ponds which can accumulate large quantities of toxic pollutants (see Section 5.2.1 above). As shown in Table 5-3, the potential for pollution from ponds can be reduced by improving the design and maintenance of ponds and by treating pollutants before they are discharged. Improved design includes the use of natural or synthetic liners to eliminate seepage and reinforcing the sides of ponds to reduce the potential of berm failure.

Pretreatment of effluents could also be used to reduce the quantities of toxic substances being discharged.[2] Pretreatment would necessitate disposal of sludge generated by these treatment processes by decomposition, dewatering, and sanitary landfill disposal or possibly incineration.

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[1] No comprehensive description or evaluation of the objective to revise current water quality goals and requirements is made in this chapter. However, since this objective may become increasingly feasible, it will be considered for further attention during the fourth year of this project.

[2] Pretreatment could include such processes as chemical coagulation and sedimentation (clarification) and carbon absorption.

TABLE 5-3: IMPLEMENTATION STRATEGIES FOR IMPROVING WATER QUALITY CONTROLS

ALTERNATIVE	IMPLEMENTATION STRATEGY	CONSTRAINT
Control effluents from energy conversion facilities		
Improve design of holding ponds	Modify Federal Water Pollution Control Act and Clean Water Act or require best available or best practical pond liners	Economic advantages of holding ponds would be reduced, and costs of the energy product would be increased.
	Require pond monitoring and institute penalties for pond failure	Monitoring may be very difficult or expensive.
Pretreatment of effluents prior to pond discharge	Require pretreatment of most toxic pollutants	Economic costs of energy products would be increased.
Select energy conversion facilities and locations which minimize water quality problems	Provide subsidies for "cleanest" technologies	Uncertainty about comparative water quality impacts of various technologies.
	Develop comprehensive siting mechanisms which avoid worst-case technology location combinations	Water quality is only one factor in decisionmaking on siting. New siting institutions would be required to make these decisions.
Control effluents from municipal wastewater		
Secondary and tertiary treatment	Federal funding to construct treatment facilities	Current construction program has had limited success at high public expense.
Land applications of municipal sewage	Increase grants for research and development through Section 208 of the Federal Water Pollution Control Act	Considerable uncertainty about effectiveness and potential environmental hazards.
Control nonpoint source pollution		
Reduce runoff from energy facilities	Modify 208 planning process to establish performance standards for various runoff intensities	Control is very difficult in some topographical conditions.
Reduce runoff from agricultural lands	Require mechanical irrigation systems to improve irrigation efficiency	State appropriation systems would have to be modified to create water rights for salvaged water.
	Federal subsidies for construction of new irrigation systems	Further federal subsidies for irrigated agriculture may be politically infeasible, yet farmers generally cannot afford increased production costs, including water prices.
	Pay farmers to withhold marginal lands from production	
	Increase water prices for less productive acreage	
	Provide guarantees or subsidies to reduce risks of growing crops which are not water intensive	
Reduce erosion	Federal funds to increase capacity of local areas to manage urban and rural erosion	Fragmentation of responsibility among federal agencies dealing with erosion and sedimentation control

Both improved pond design and pretreatment could be implemented by modifying the FWPCA[1] and the CWA;[2] for example, ponds could be required to employ the best available or practicable liners, pretreatment could be required, and monitoring and penalties could be established for violations. The primary constraint on these alternatives appears to be economic, since the price of energy products would be increased.

Policymakers may also reduce the potential for water quality pollution by regulating the combinations of technologies and sites which are permitted. For example, if siting conversion facilities close to flood plains is prohibited, the potential for the contents of a pond to be washed out into surface streams will be greatly reduced. Policymakers can also discourage facilities which produce the most liquid effluents and which are the most labor intensive. (The more labor-intensive a technology, the more severe municipal wastewater treatment problems are likely to be.) For example, electric power generation facilities produce more liquid effluents than any of the other coal conversion facilities considered in this study. And Synthoil liquefaction produces less liquid effluents than do either Lurgi or Synthane gasification processes. Further, gasification processes are the most labor-intensive of the six conversion facilities examined (see Section 5.2.1 above). And, of the two oil shale development alternatives considered, in situ processes produce much lower quantities of effluents than does TOSCO II surface retorting.[3] The choice of technology and location appear to present more difficult implementation problems than do other options for controlling pollution from energy conversion facilities. For example, if synthetic coal processes are chosen, subsidies are likely to be required for these facilities to be commercially viable; and for technology-location combinations to be considered systematically and in detail, innovative institutional mechanisms would be required which ensure that the range of values at stake in the siting process get taken into account.

Improving the effectiveness of water quality controls also includes municipal wastewater treatment. As suggested in the discussion of water quality problems and issues in Section 5.2, energy resource development will also contribute to water quality problems associated with municipal wastewater. This is a direct consequence of population increases attributable to energy development. But the problem is exacerbated by the fact that most communities impacted by energy development will be incapable of meeting the secondary treatment requirements of the FWPCA.[1] Tertiary treatment may also be needed to control salinity and further reduce pollutants such as nitrogen and phosphorus.[2] In order to implement secondary and tertiary controls, federal construction grants will be required; and these grants may need to be tailored specifically to the needs of predominantly small, rural communities most likely to experience rapid population growth as a consequence of energy development. However, the "public works" approach to municipal water quality problems is likely to be constrained by the limited success achieved by the current wastewater treatment program. Although large public expenditures have been authorized, the program's complicated implementation procedures have delayed the actual application of those funds to constructing new sewage treatment systems.[3]

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[1] Federal Water Pollution Control Act Amendments of 1972, Pub. L. 92-500, 86 Stat. 816.

[2] Clean Water Act of 1977, Pub. L. 95-217, 91 Stat. 1566.

[3] See Chapter 12, Energy Facility Siting, for a more detailed discussion of the role that the selection of a technology and location play in determining the impacts of energy resource development.

Municipal wastewater control may also be aided by improving technologies for land applications of municipal sewage. EPA is considering several potential application methods for using municipal sewage to fertilize the growth of certain plants, including irrigation, infiltration-percolation, and spray runoff.[4] However, there is still a great deal of uncertainty about potential environmental hazards and the availability of suitable locations for land applications.

Improving the control of nonpoint source pollution includes controlling runoff from energy facilities and from agricultural lands and reducing rural and urban erosion. For energy facilities, improvements include requiring contoured topography and revegetation to reduce runoff from mines. Although this alternative does not appear applicable in complex terrain, such as that occurring in southern Utah or western Colorado, improvements could easily be implemented through the existing 208 planning process.

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[1] Refer to Chapter 9, Growth Management, for an elaboration of this problem.

[2] Primary treatment involves screening and usually sedimentation to remove gross solid material. Secondary treatment removes fine solid material and oxygen demanding wastes by the use of such processes as trickling filters and activated sludge units. Tertiary treatment, such as chemical treatment with lime or the use of activated carbon, is used to remove specific chemicals remaining in the wastewater.

[3] Kirschten, J. Dicken. "Plunging the Problems from the Sewage Treatment Grant System." National Journal, Vol. 9 (February 5, 1977), pp. 196-202.

[4] Pound, Charles E., Ronald W. Crites, and Douglas A. Griffes. Costs of Wastewater Treatment by Land Application, Technical Report. Washington, D.C.: U.S., Environmental Protection Agency, Office of Water Program Operations, 1976.

Alternatives for controlling agricultural nonpoint sources include increasing the efficiency of irrigation systems, managing crop-use to eliminate water-intensive crops, removing marginal lands from production, and improving conveyance systems. Increasing the efficiency of irrigation systems could be accomplished by switching from flood and furrow to mechanical methods, such as sprinkler systems. Managing crop-use to eliminate water-intensive crops could be accomplished by substituting vegetables for forage crops or corn for sorghum. Together with removing marginal lands from production, these alternatives could improve water quality by reducing saline return flows and by avoiding water losses which decrease the dilution of dissolved solids from existing flows. Conveyance systems can be improved by lining canals and installing pipe to reduce water losses in percolation and evaporation and eliminate soil leaching. Several programs to control nonpoint sources have been established by the federal government and are implemented by state agencies. Extending these programs would probably require large federal subsidies or incentives. For example, establishing a planning process for a state to develop areawide wastewater management from runoff would typically involve expenditures well in excess of a million dollars; and additional planning would have to be conducted at the federal level.[1]

Coordination among federal agencies including EPA, the Bureau of Reclamation, and the Soil Conservation Service in the Department of Agriculture would also be necessary. For example, increasing irrigation efficiency by using trickle or sprinkler systems rather than less capital-intensive flood and furrow methods could be an effective way to control saline runoff return.[2] But it is also costly and has widespread pricing implications for maintaining or improving water quality, providing water supplies, and for agricultural development. Costly programs can either lead to more farm subsidies or raise costs for farmers and prices for consumers.

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[1] U.S., Environmental Protection Agency. Areawide Wastewater Management Planning Program. Washington, D.C.: Environmental Protection Agency, n.d.

[2] Utah State University, Utah Water Research Laboratory. Colorado River Regional Assessment Study, Part I: Executive Summary, Basin Profile and Report Digest, for National Commission on Water Quality. Logan, Utah: Utah Water Research Laboratory, 1975.

Another implementation strategy would be to internalize costs. For example, the Environmental Defense Fund has suggested that "salinity rights" be applied to water. Thus, farmers would either have their water rights reduced or pay more for water if runoff from their farm contributed more than a specified amount to the salinity of a stream. If each farm's contribution to salinity could be measured, this system would provide an incentive to improve irrigation efficiency, change crop patterns, or remove some lands from production.

Another strategy would be for states to modify their appropriation systems to create water rights for "salvaged water" thereby removing one of the disincentives for irrigation conservation.

B. Treat Surface Waters

Since much of the salt from man-made or natural sources may be difficult to manage by either point or nonpoint controls, the second category of alternatives is to treat surface water effluents, either by desalination plants, diverting flows around areas of high salt pick-up, or eliminating saline flows by evaporation.

Technologies for desalination include chemical pretreatment and several methods for separating dissolved solids from water, such as freezing, distillation, and filtering through membranes to remove brine (reverse osmosis). In the case of the desalting complex authorized by the Colorado River Salinity Control Act of 1974,[1] a combination of chemical pretreatment and membrane systems are to be used.[2] This plant, now scheduled for completion in 1981, would treat about 150,000 acre-feet of saline agricultural runoff each year and remove about 600,000 tons of dissolved solids per year.[3] Brine discharge from this plant would be diverted from Yuma, Arizona, to a drainage which terminates in the Gulf of California. In other locations distant from marine water, brines could be disposed by evaporation or removal to isolated groundwater formations.

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[1] Colorado River Salinity Control Act of 1974, Pub. L. 93-320, 88 Stat. 266.

[2] Construction of the Las Vegas Wash Unit is currently delayed by several factors, including a suit filed by the cities of Las Vegas and North Las Vegas against EPA and Clark County to terminate plans for an advanced wastewater treatment plant that is a part of the salinity project, a reassessment of the economic benefits of the project, and a conflict over water rights between the state of Nevada and the Bureau of Reclamation. U.S., Department of the Interior, Bureau of Reclamation Staff. Personal Communication. August 1978.

[3] Ibid.

Diversions of streams around areas of high salt pick-up can also contribute to desalination, and, in fact, several diversions are included in plans for the Colorado River. Impoundments are used to prevent high saline waters from flowing into a stream in which salinity is being controlled; and canals are used to circumvent saline seeps or formations. This option is being considered for the Paradox Valley Unit of the Colorado River Salinity Improvement Program.[1]

Since return flows from agriculture are a large contributor to salinity, attempting to control salinity by eliminating return flows would have to include eliminating agricultural return flows. Given the volume involved, this would require many large ponds. However, this is at times a viable option, and this approach is to be used for the Las Vegas Wash Unit of the Colorado River Salinity Control Project.

As shown in Table 5-4, implementing stream flow treatment alternatives will involve major expenditures on the part of the federal government; but it will also provide reliable water quality improvement. For example, five desalting projects were originally authorized by the Colorado River Basin Salinity Control Act, and commitments were made to 12 others if planning reports were favorable.[2] Hence, this alternative could be implemented with existing programs and agreements in the Colorado River Basin. Implementation of this alternative involves substantial economic costs on the general public rather than on the agricultural and industrial sectors most involved.

5.3.3 Evaluation of Alternatives

A. Evaluation Criteria

As indicated in Chapter 3, five basic criteria are being used by the research team to assess and compare alternative policies and implementation strategies: effectiveness, efficiency, equity, flexibility, and implementability. Each of the five is defined in terms of the substance of water quality problems and issues in Table 5-5. The use of these criteria illuminates the kinds of trade-offs policymakers will have to face as demands for the use of scarce water resources continue to increase and the quality of water is either threatened or reduced. It is probably

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[1] Colorado River Salinity Control Act of 1974, Pub. L. 93-320, 88 Stat. 266, Title II.

[2] Colorado River Salinity Control Act, Section 320.

TABLE 5-4: IMPLEMENTATION STRATEGIES FOR TREATING RETURN FLOWS

ALTERNATIVE	IMPLEMENTATION STRATEGY	CONSTRAINT
Desalination plants	Federal funding for construction of plants Coordination with Colorado River Salinity Control Forum	Very high economic costs Plants only useful in areas of highly saline flows
Flow diversion around areas of high salt pick-up	Federal funding for impoundments or canals Public and private sector coordination to locate projects in suitable locations	Environmental problems are associated with diversions Economic costs are high
Evaporation ponds	Federal or state subsidies for constructing the ponds Payments to water right holders whose rights would be damaged	Total quantities of consumable water would be reduced Few suitable sites appear available

impossible to develop or choose individual alternatives or combinations which satisfy all of these criteria. Hence this assessment is intended to inform policymakers generally about the likely consequences of choosing an alternative.

As suggested in Table 5-5, these five criteria address two general kinds of questions. The first is "how much improvement in water quality can be achieved?" Thus, attention is given to how existing stream flow or runoff can be improved and to what extent this improvement can be achieved given a range of costs, risks and benefits for given options and what people, groups, and sectors of society will be benefited or deprived. The second general question is "what is the optimum process for implementing water quality improvements?" In part this question refers to

TABLE 5-5: EVALUATIVE CRITERIA FOR WATER QUALITY ALTERNATIVES

CRITERIA	AS APPLIED TO WATER QUALITY	MEASURES
Effectiveness Achievement of policy objective	How much can salinity (TDS) and BOD be reduced? How certain is the solution? Can risks of large scale pollution be reduced?	Quantitative: Tons removed per year Percentage change in salinity BOD and TDS Qualitative: Are risks of water pollution increased or decreased? Water quality improved or degraded?
Efficiency Costs, risks and benefits	What is the cost of a given reduction in stream salinity? How much energy is expended or land used to achieve water quality improvements? What are the environmental risks?	Quantitative: Dollar costs per unit of pollution reduced Btu's used or saved? Qualitative: Are risks acceptable or unacceptable?
Equity Distribution of costs, risks, and benefits	Geographic: What is the geographic distribution of costs, risks, and benefits, particularly in river basin and subbasins and among states in the region? Sectoral: What is the distribution of costs, risks, and benefits, particularly to recreational, industrial, and agricultural interests?	Qualitative: What states are benefited or deprived? Will interregional and intraregional conflicts be increased or decreased? Which interests will gain and which will lose? What is the ability-to-pay of stakeholders? Will politicians and stakeholders be willing to pay?
Flexibility Adaptability to locational needs and changes over time	Is the option adaptable to different locations or times? Is the option reversible?	Qualitative: Can locational variances be obtained? Degree of reversibility Degree of state and local responsibility
Implementability Adaptability and acceptability	What existing laws, regulations, and programs need to be changed? How many agencies and levels of government are involved? How will parties-at-interest respond?	Qualitative: Degree of innovation required Degree of governmental coordination required Are parties-at-interest likely to respond positively or negatively?

TDS = total dissolved solids

BOD = biochemical oxygen demand

Btu = British thermal unit

whether or not specific options can be implemented and are flexible enough to deal with changing water quality problems and needs. However, this question also has another aspect--whether or not alternatives are capable of accommodating diverse local or regional interests in the policymaking process. As suggested in Section 5.2, conflicts over access to policymaking and the appropriate roles and responsibilities of various participants are a dominant theme in the policymaking system. Indeed, "best management practices" now being developed in the West for 208 areawide water quality management must be legitimated through a public review process which takes into account local public and private concerns. The implementability of alternatives is in part a function of how choices compare to accepted social values, a difficult-to-apply criterion. However, in the case of water quality, some of these values are embodied in the goals of existing legislation, such as water quality, agriculture, economic development, and conservation legislation, for example. Implementability is also affected by the extent to which changes in existing law are required and the extent to which bureaucratic cooperation is required.

B. Evaluation of Controlling Pollution Sources

(1) How Much Can Water Quality Be Improved?

Policymakers apparently have a variety of alternatives for effectively reducing pollution from its source. If salinity and biochemical oxygen demand (BOD) are the primary concerns, improved municipal and nonpoint source control could eliminate thousands of tons of pollutants per year. Although existing data are inadequate for a precise rank ordering of all alternatives, controlling agricultural sources of pollution appears to be an effective choice. Improving irrigation efficiency, using water-efficient crops, and improving conveyance systems by lining canals can each apparently reduce salt content by 700,000 to 1,000,000 tons per year in the Colorado River Basin.[1] Improving conveyance systems by lining canals has the additional advantage of diluting pollution, since less water is lost to percolation and evapotranspiration and, therefore, more runoff ultimately is returned to the stream.

Other alternatives for controlling runoff and erosion can also improve water quality, although probably not as effectively as the alternatives mentioned above. Erosion control on nonagricultural lands and removing marginal agricultural lands from production may be capable of removing 50,000 to 500,000 tons of salt per year.[1] Municipal effluent control is apparently less effective in reducing salt load. Comprehensive treatment is estimated to eliminate from 3,500 (secondary) to 60,000 (tertiary) tons per year on a regional basis.[2] These choices can also reduce BOD by about 12,000 (secondary) to 13,000 (tertiary) tons per year. Controlling runoff from energy facilities is probably the least effective alternative in terms of total pollution reduction, largely because total land areas directed to surface mines are relatively small regionwide.[3] However, controlling runoff from energy facilities may be useful in areas of very poor water quality and relatively higher rainfall.

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[1] Estimates are derived from cases E-1, E-2, and E-3 in Utah State University, Utah Water Research Laboratory. Colorado River Regional Assessment Study, Part II: Detailed Analyses: Narrative Description, Data, Methodology, and Documentation, for National Commission on Water Quality. Logan, Utah: Utah Water Research Laboratory, 1975, pp. 159-63.

Requirements for holding ponds to be well-designed, built and equipped with synthetic liners, or pretreating effluents before discharge can also reduce salinity and BOD content. Pond design improvements can eliminate about 40,000 tons of salinity and about

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[1] These estimates assume 50 percent of salt load originates from agricultural land and 50 percent from nonagricultural lands and that 1 to 10 percent of both agricultural and nonagricultural lands are manageable. See Utah State University, Utah Water Research Laboratory. Colorado River Regional Assessment Study, Part II: Detailed Analyses: Narrative Description, Data, Methodology, and Documentation, for National Commission on Water Quality. Logan, Utah: Utah Water Research Laboratory, 1975, p. 105; and Leathers, K.L., and R.A. Young. "Economic Evaluation of Non-Structural Measures to Control Saline Irrigation Return Flows." Paper presented at the Western Agricultural Economics Association Meeting, Las Vegas, Nevada, July 1975.

[2] These estimates represent improvements over primary treatment, assuming population increase of about 650,000 by the year 2000 in the eight-state area, 0.17 pound BOD per person per day, and 0.58 pound salinity per person per day. Secondary treatment assumes 90 percent BOD removal and 5 percent salinity removal. Tertiary treatment assumes 98 percent BOD removal and 90 percent salinity removal. See Wolman, Nat, and Gilbert Bonem. The Outlook for Water: Quality, Quantity, and Economic Growth. Baltimore, Md.: Johns Hopkins Press, 1971.

[3] Depending on the level of development, between 1,000 and 1,500 square miles of land could be disturbed in the eight-state study area by the year 2000 by coal mining. See Chapter 7, Land Use and Reclamation.

1,000 to 3,000 tons of BOD on a regional basis.[1] Pretreatment can eliminate 7,000 to 15,000 tons of salinity and 5,000 to 13,000 tons of BOD.[2] However, these options appear better suited to reduce the biggest potential risk from holding pond failure, acute contamination of surface water and groundwater from the toxic chemicals which they store. Although there is considerable uncertainty with regard to both the potential danger of toxic substances and the effectiveness of improved pond design and pretreatment, these alternatives would almost certainly reduce the risks of ecological and environmental damage from accidental release or seepage of toxic substances.

(2) What are the Costs, Risks, and Benefits?

The economic efficiency of most alternatives to improve the control of pollution sources depends on where and how they are used. For example, costs of improved pond design depend on the type of conversion facility and size of the pond, and the cost of tertiary treatment of municipal wastewater depends on size of facility. Thus, as shown in Table 5-6, dollar costs for eight alternatives range widely.

These data suggest that average costs per year per ton of salt removed are lowest for control of sources related to agriculture. This is particularly true for removal of marginal lands, crop switching, and improved conveyance systems which cost $70 or less per ton of pollutant removed. Improving irrigation efficiency will cost at least four times as much. Assuming primary

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[1] Assuming 1 to 5 percent of ponds would fail without hydraulic concrete and 2 to 10 percent of wastes would leak without synthetic liners. Estimates are derived from the Low Demand Case for the year 2000. See Low Demand Case of the Stanford Research Institute (SRI) Model as described in Cazalet, Edward, et al. A Western Regional Energy Development Study: Economics, Final Report, 2 vols. Menlo Park, Calif.: Stanford Research Institute, 1976. These calculations are for the projected increase in population for the eight western states due to energy development. See White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming, Chapter 12. The Low Demand Case corresponds to a total U.S. energy supply of 124.0 x 10^{15} Btu's (British thermal units) (10^{15} Btu's = 1 Q) of energy for the year 2000. About 37 percent of the energy supply is projected to come from the eight western states.

[2] Assuming reverse osmosis to remove 93 percent of salinity and 95 percent BOD. See Wolman, Nat, and Gilbert Bonem. The Outlook for Water: Quality, Quantity, and Economic Growth. Baltimore, Md.: Johns Hopkins Press, 1971.

TABLE 5-6: ECONOMIC COSTS OF CONTROLLING POLLUTION SOURCES (dollars per year per ton removed)[a]

ALTERNATIVE	SALINITY	BOD
Energy facilities		
Holding pond design[b]	14,000-54,000	83,000-330,000
Pretreatment and minimal ponding[c]	3,800-14,240	25,250-93,500
Municipal		
Secondary treatment[d]	1,700-2,100	500-600
Tertiary treatment[e]	400-500	1,800-2,300
Agricultural		
Irrigation efficiency[f]	190-310	NA
Remove marginal agricultural lands from production[g]	10-15	NA
Crop switching[g]	20-70	NA
Conveyance systems[f]	14-30	NA

BOD = biochemical oxygen demand NA = estimates not available

[a] Assumes total costs are averaged per year over a 25-year span. These costs are in 1975 dollars and have increased significantly since then, perhaps by 100 percent or more. The relative differences in costs between alternatives are most important and not the absolute costs.

[b] Range in estimates is principally due to differences among energy conversion facilities regarding quantities of water discharged to ponds and surface area of ponds. Differences also depend on design--costs for hydraulic concrete are slightly higher than synthetic liners. See Radian Corporation. Survey of Technological and Environmental Aspects of Wet-Residue Disposal in Evaporative Holding Ponds. Austin, Tex.: Radian Corporation, forthcoming.

[c] Battelle Memorial Institute, Pacific Northwest Laboratories. Evaluation of Municipal Sewage Treatment Alternatives, Final Report for Council on Environmental Quality and Environmental Protection Agency. Richland, Wash.: Battelle, 1974. Minimal ponding includes the cost of natural liners at about one-fourth the cost of synthetic liners as assumed in the holding pond design alternative.

[d] Estimates are for costs above primary treatment and assume conventional sedimentation and trickling filter for nine facilities of 10 million gallons per day capacity. See Van Note, H.R., et al. A Guide to the Selection of Cost Effective Wastewater Treatment Systems. Washington, D.C.: U.S., Environmental Protection Agency, 1975.

[e] Assumes treatment beyond secondary to include two-stage tertiary lime treatment, filtration, activated carbon, ion exchange, and disinfection. See Van Note et al. Cost Effective Wastewater Treatment.

[f] Utah State University, Utah Water Research Laboratory. Colorado River Regional Assessment Study, for National Commission on Water Quality. Logan, Utah: Utah Water Research Laboratory, 1975, Parts I and II.

[g] Leathers, K.L., and R.A. Young. "Economic Evaluation of Non-Structural Measures to Control Saline Irrigation Return Flows." Paper presented at the Western Agricultural Economics Association Meeting, Las Vegas, Nevada, July 1975.

municipal treatment exists, secondary treatment costs about $1,700 to $2,100 per year per ton of salt removed, and tertiary treatment adds $400 to $500 to this figure.

The least efficient options for controlling effluents on a regional basis are those for energy facilities, if salinity and BOD are the target pollutants. Improved pond design is estimated to cost at least 70 times more than the most expensive agricultural control option (irrigation efficiency) and at least 8 times more than secondary treatment of municipal wastewater. A much more efficient alternative for controlling salinity from energy facilities is to pretreat the effluents, costing about one-third as much per ton of salt removed. However, "fail safe" pond design and pretreatment are not primarily intended to reduce salinity and BOD, and no estimates have been made of the efficiency of these alternatives in reducing hazardous and toxic substances.

Most of these alternatives will have few environmental or ecological costs or risks, and some will have positive effects in addition to improving water quality. Increasing irrigation efficiency, removing marginal lands from production, and crop switching can potentially increase stream flows and, therefore, benefit aquatic habitat and recreational uses of water. However, these alternatives may threaten wetlands in some areas. This risk is greatest regarding irrigation efficiency, since runoff often contributes to wetlands.

(3) How Will Costs, Risks, and Benefits Be Distributed?

The equity of improving water quality control depends on both the mix of alternatives and the implementation strategies used. In general, if these alternatives are broadly employed, costs will be distributed among those responsible for water pollution (industrial, energy, agricultural, and municipal sources) and across most of the states in the region. If only one category of alternatives is used, for example improved control of energy facility effluents, costs for controlling pollution originating from a variety of sources will be disproportionately placed on that one particular source.

If ability-to-pay is considered, municipal and agricultural interests will probably absorb the largest costs and risks, unless federal money is used to install secondary or tertiary wastewater treatment systems for municipalities and mechanical irrigation systems for farmlands. Without federal help, it appears that many farmers and many western towns will be unable to finance these improvements. The implications are that many farmers could be put out of business or forced to reduce total irrigated acreage and that growth in many towns could be restricted. If federal support is available, the costs of water quality control are ultimately transferred to the taxpayer. Energy resource developers appear much more capable of affording price increases, since cost increases would generally represent a small percentage of the capital investment and operating costs of a conversion facility. Increases could also be easily transferred to the energy consumer, in which case the costs of water quality improvement in the West would be paid largely by consumers in other regions.

Beneficiaries of the alternatives would be varied. Improving the control of energy facility effluents would benefit both surface and groundwater users by reducing the risks of acute contamination. This may most directly benefit municipal interests close to energy facilities which often depend on groundwater resources for water supplies. Environmental interests would also benefit from this alternative, as well as from improved control of municipal and agricultural pollution, since the risk of instream and recreational values being damaged would be reduced. Downstream water users will apparently benefit more from improved pollution control than will upstream users. This is particularly true for alternatives which reduce runoff from agricultural lands. However, this does not necessarily create an inequitable situation. Since much downstream pollution in the Colorado River Basin originates in the Upper Basin, an equitable solution may be one which emphasizes pollution control in the Upper Basin. Whichever alternatives are chosen, they are likely to increase perceptions in the Lower Basin states that the Lower Basin pays a disproportionate share of the costs of pollution from the Upper Basin. This situation is the reverse of water availability, in which case the Upper Basin states generally perceive themselves as being disadvantaged in the division of the total Colorado River flow.

(4) Are the Alternatives Flexible?

Flexibility can be measured by the extent to which alternatives are reversible and can be applied in several locations. Among the alternatives being considered, those based primarily on management strategies are generally the most reversible; these include removing marginal lands from production, selecting water efficient crops, and controlling erosion from nonfarm lands. The least reversible choices appear to be those which require large capital investments, specifically secondary and tertiary treatment of municipal wastewater, lining irrigation canals, and pretreating energy facility effluent.

The adaptability of these alternatives to local conditions depends on how they are implemented. For example, if regulations specify a particular type of pond liner, the performance of that liner will vary with changing environmental conditions since liner types vary in their ability to withstand extremes in temperature and sunlight. However, if a performance standard is used, such as specifying a maximum allowable seepage rate, the liner could be selected according to local environmental conditions. Considerable uncertainty is associated with the adaptability of pretreatment of pond effluents, especially with regard to the nature of the pollutants that would have to be removed and the appropriate treatment processes. The uncertainties are largest for synthetic fuel processes.

Even though most alternatives for controlling pollution from agricultural and municipal sources are not easily reversed, they can generally be applied in a variety of locations. In controlling municipal effluents, this appears to be more the case with regard to secondary than tertiary treatment. This is, in part, due to there being less engineering experience with tertiary treatment. With regard to controlling pollution from runoff and erosion, most alternatives can be used region-wide. However, control of erosion from nonfarm lands is more appropriate in the arid Southwest where there is less vegetative cover and there is more erosion.

(5) Can the Alternatives Be Implemented?

The obstacles to be overcome for policies to control agricultural and municipal sources of pollution are formidable. For agricultural policies, this is largely because of the degree of change required in the existing system, including both the behavior of the individual farmer and the complex infrastructure supporting irrigated agriculture. For example, even if incentives for crop switching are provided, farmers who have grown a particular type of crop for years may resist any substantial changes in crop patterns. Many farmers are also likely to resist alternatives such as removal of marginal lands from production and improved irrigation systems because of the economic cost. Ditch and irrigation companies are likely to oppose requirements to improve conveyance systems, also because of the costs. Although each of these alternatives can be supported by public revenues, many interest groups would be opposed since they argue that existing federal subsidies in the form of artificially low water prices already contribute to inefficient irrigation practices.

Secondary and tertiary wastewater treatment would be primarily constrained by the need for larger construction grants, perhaps requiring new legislation specifically aimed at western towns. Such strategies may be very difficult to implement given the problems with existing construction grant programs and the economics of municipal wastewater treatment. Specifically, it has been argued that construction grants both contribute to uneconomical technological choices and fail to provide any incentives for municipalities to operate facilities efficiently.[1]

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[1] Changing industrial technologies or reaerating water at the end stage have been suggested as more economical technologies. See Rhoads, Steven E. "Economists and Policy Analysis." Public Administration Review, Vol. 38 (March/April 1978), p. 118.

Enactment of policies to control energy facility effluents either by improving holding ponds or pretreatment would require either changes in the FWPCA or CWA or new state laws. Revisions in the regulatory structure could include preuse definitions of best available control technology and standards to control the design of ponds or allowable seepage from ponds. These strategies would probably generate substantial opposition from stakeholders in both the electric power and synthetic fuels industries because of the associated cost increases.

(6) Summary Evaluation of Controlling Pollution Sources

Table 5-7 summarizes the evaluation of alternatives for controlling sources of water pollution. If salinity is the primary concern, alternatives for controlling agricultural sources, particularly improving irrigation efficiency, using water efficient crops, and improving conveyance systems, appear the most effective. Alternatives for controlling pollution from energy facilities and mining wastewater can also be employed to remove thousands of tons per year of salinity and BOD on a region-wide scale.

Several agricultural control alternatives are also reasonably efficient, measured by dollar costs per ton of pollutant removed per year. Improving conveyance systems, removing marginal lands from production, and crop switching are the most cost-effective ($10 to $70 per ton) in removing salinity. However, improving irrigation efficiency will apparently cost four to nine times as much to remove a comparable quantity of salinity. Most of the options for agricultural control will have overall positive environmental effects, such as increasing water availability and stream flows.

Although several agricultural alternatives are generally effective and efficient, they appear to face severe constraints regarding how they will be financed and implemented. Agricultural interests are generally incapable of absorbing construction costs of improved pollution control, and further subsidies to irrigated agriculture will probably generate serious political opposition. Further, implementation of some of these alternatives may require significant changes in the current regulatory structure, including state appropriation systems.

Improved control of municipal pollution by secondary and tertiary treatment is considerably less cost-effective than control of agricultural pollution, costing at least seven times as much as improved irrigation efficiency per unit of salinity removed. Further, if these programs are implemented as previous municipal wastewater treatment programs have been, there will be few if any incentives for the development of new technologies or for municipalities to operate plants efficiently. For these and other reasons, enactment of municipal wastewater control alternatives are

TABLE 5-7: SUMMARY EVALUATION OF ALTERNATIVES FOR CONTROLLING POLLUTION SOURCES

CRITERIA	MEASURES	FINDINGS
Effectiveness Maintain and improve water quality	Tons of salt and BOD removed per year	About 0.7 to 1.0 million tons of salinity can be removed per year by improving irrigation efficiency, using water efficient crops, or improving irrigation conveyance systems. Alternatives for controlling municipal and energy facility effluent are less effective but can potentially reduce salinity by 40,000 (pond design improvements) to 60,000 (tertiary treatment) tons per year. Tertiary municipal treatment and holding pond design improvements can also reduce BOD by as much as 13,000 tons per year.
	Risks of acute pollution	Improved holding pond design and pretreatment of energy facility effluents can reduce the risks of toxic substances reaching surface water or groundwaters, but considerable uncertainty exists about the nature of these pollutants as well as the potential risk.
Efficiency Costs, risks, and benefits	Dollar costs per year per ton of pollutant removed	Agricultural control options, particularly removing marginal lands from production, improving conveyance systems, and crop switching, are most cost effective for controlling salinity on a region-wide or basin-wide level, costing $70 or less per ton of salt removed. All other options examined are considerably less efficient. Efficiency of improved holding pond design and pretreatment of effluents to control toxic substances is uncertain.
	Environmental costs, risks, and benefits	Most alternatives have overall positive environmental effects such as increasing stream flows or improving aquatic habitats. Some wetlands may be threatened by improved irrigation efficiency and by decreasing runoff and erosion. Agricultural control alternatives generally increase water availability.
Equity Distribution of costs, risks, and benefits	Who will benefit?	Municipal water users will face lower risks of contaminated water supplies. Environmental interests for instream values and aquatic habitat will benefit. Downstream users will generally benefit, although not necessarily disproportionately, given their contribution to water quality problems.

TABLE 5-7: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity (Continued)	Who will pay?	Residents of other regions may pay for western water quality control in order to use the West's energy resources. Taxpayers in general will pay for these options.
	Ability to pay	Agricultural interests are generally incapable of absorbing construction costs of improved pollutant control. Western towns impacted by rapid population increases will generally be unable to meet secondary or tertiary treatment goals. Energy industrials will generally be able to afford these alternatives.
	Willingness to pay	Further federal subsidies for irrigated agriculture and municipal wastewater treatment may be politically infeasible. Taxpayers appear increasingly unwilling to pay higher taxes.
Flexibility Adaptability to locational needs and changes over time	Reversibility	Alternatives relying on management strategies are most reversible (crop switching, removing marginal lands from production, erosion control). Alternatives requiring large capital investments or construction programs are least reversible (municipal wastewater treatment, lining irrigation canals, pretreating energy facility effluent).
	Adaptability	Most alternatives appear adaptable to local conditions, depending on implementation strategies. Adaptability of pretreatment of energy facility effluents and tertiary treatment is uncertain.
Implementability Adoptability	Adoptability	Enactment of alternatives to control municipal and agricultural sources of pollution will require largest changes in existing regulatory system and generate substantial opposition from stakeholders and interest groups. Enactment of alternatives to control energy facility sources appears adoptable.

BOD = biochemical oxygen demand

expected to generate opposition from other parties-at-interest and be difficult to implement.

Although relatively less effective than other choices for controlling salinity and BOD, programs to improve control of pollution from energy facilities may be the most important water quality control measures because of the potential danger of toxic substances being released from on-site evaporative holding ponds. Just how effective regulations to improve holding pond design or to require pretreatment of effluents will be is not at all clear. However, costs appear to be manageable for most energy producers, and should not rule out this alternative.

Improved design of holding ponds can be adapted to locational situations. It is less clear that pretreatment requirements are this adaptable. Neither option appears to present the implementation difficulties associated with alternatives to control municipal or agricultural pollution.

C. Evaluation of Alternatives to Treat Surface Waters

(1) How Much Can Water Quality Be Improved?

Three specific alternatives for treating surface waters are evaluated in this section: desalination plants, flow diversion around areas of high salt pick-up, and on-site evaporative holding ponds. Among these alternatives, desalination plants offer the greatest potential for removing salinity. Five large desalination plants on the Colorado River could remove up to 3 million tons of salt per year.[1] This removal rate would be considerably larger than that for any option for controlling point sources of salinity, and about three times as effective as improved irrigation efficiency. Other alternatives for treating flows are less effective than desalination plants but can still remove large quantities of salt. Containing or diverting flows can apparently remove 300,000 to 400,000 tons of salt per year,[2] and evaporating return flows can remove 10,000 to 100,000 tons per year.[1]

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[1] This assumes each plant would be equivalent to the proposed Yuma desalination facility. See U.S., Department of the Interior, Bureau of Reclamation. Status Report: Yuma Desalination Test Facility. Boulder, Colo.: Bureau of Reclamation, 1978, pp. 67-69.

[2] This assumes two plants comparable to the Delores River Bypass. U.S., Department of the Interior, Bureau of Reclamation, and Department of Agriculture, Soil Conservation Service. Final Environmental Impact Statement: Colorado River Water Quality Improvement Program. Denver, Colo.: Bureau of Reclamation, Engineering and Research Centers, 1977, p. I-80.

(2) What Are the Costs, Risks, and Benefits and How Will They Be Distributed?

Treating return flows ranks among the most efficient alternatives for improving water quality, largely because it can be applied to areas of highly saline flows. In such locations, desalination plants and evaporating return flows can remove a ton of salt for approximately $30 to $40.[2] Flow containment or diversion costs from $10 to $100 per ton of salt removed.[3]

Equity considerations of these alternatives closely parallel those of alternatives for controlling pollution sources. Taxpayers will ultimately pay many of the costs, since each alternative is capital-intensive and each will require public, probably federal expenditures. Taxpayers living in regions other than the West will pay a disproportionate share of these costs, unless the alternatives include implementation strategies which assess water users for the cost of the project. However, this strategy will probably increase conflicts among the Upper and Lower Basins of the Colorado, since downstream users would be paying for problems largely originating in the Upper Basin.

(3) Are the Alternatives Flexible and Implementable?

The flexibility and implementability of these alternatives are constrained by their generally high capital costs, particularly for desalination plants, and by their requirements for suitable locations of highly saline flows. Thus, it appears unlikely that more than a few of any of these kinds of facilities could be located on the Colorado River.

The legal and regulatory basis has already been established for each of these alternatives, so implementation may be less difficult than for many other alternatives for controlling pollution sources. However, containing, diverting, or evaporating flows will probably generate substantial opposition among stakeholders since water availability would be reduced and environmental values threatened. Desalination plants would apparently generate less opposition, particularly among regional interests who would not have to pay a proportional share of the costs for these facilities.

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[1] This is based on the estimate of 1.5 million tons of salinity per year originating from irrigation return flows in the Colorado River, and it assumes 0.5 to 5 percent of it can be removed by this alternative. For estimates of salinity sources, see Utah State University, Utah Water Research Laboratory. Colorado River Regional Assessment Study, Part I: Executive Summary, Basin Profile and Report Digest, for National Commission on Water Quality. Logan, Utah: Utah Water Research Laboratory, 1975, p. 65.

[2] U.S., Department of the Interior, Bureau of Reclamation. Status Report: Yuma Desalination Test Facility. Boulder, Colo.: Bureau of Reclamation, 1978, pp. 195-211.

[3] Utah Water Research Laboratory. Colorado River Regional Assessment Study, Part I, p. 262.

(4) Summary Evaluation of Alternatives to Treat Surface Water

Alternatives to treat surface flows to remove pollution are a logical choice for improving water quality since many pollution sources are ill-defined or uncontrollable, technologies for controlling many sources are unproven or very expensive, and flow treatment can be applied to specific locations where pollution content is high. As shown in Table 5-8, desalination can remove up to 600,000 tons of salt per year per plant on the Colorado River, at a cost of $30 to $40 per ton. Evaporating return flows can remove about 100,000 tons at a comparable price, and flow containment or diversion can remove 300,000 to 400,000 tons for $10 to $100 per ton.

Use of these alternatives is constrained by their high capital and/or operating costs, relative irreversibility, and scarcity of suitable locations. Further, if these alternatives are used as the primary means of pollution control, pollutors may have no incentive to control pollution sources, and thus, many stream segments will be polluted upstream of treatment facilities. Flow containment and evaporation may be infeasible in the Colorado River Basin because they reduce total quantities of water available for consumption.

5.3.4 Summary and Comparison of Alternatives

Table 5-9 summarizes and compares two general alternatives for maintaining and improving western water quality: improved control of pollution sources and treating surface waters. These alternatives address two kinds of problems. The first is the long-standing problem of salinity and BOD buildup, particularly in the Colorado River. The second, more directly related to energy resource development, is the possibility of acute contamination from toxic substances released from holding ponds.

The most effective alternatives for controlling salinity appear to be desalination, which can reduce salinity levels by approximately 600,000 tons per year per plant, and reducing runoff from irrigated agriculture, which can reduce salinity by approximately 700,000 to 1,000,000 tons per year. Although there are many other alternatives for reducing salinity, they produce only marginal improvements in comparison to those listed above.

TABLE 5-8: SUMMARY EVALUATION OF ALTERNATIVES TO TREAT SURFACE WATERS

CRITERIA	MEASURES	FINDINGS
Effectiveness How much can water quality be improved?	Tons of salt removed per year	Desalination can remove as much as 600,000 tons per year per plant on the Colorado River. This appears about twice as effective as flow diversion and six times as effective as evaporating return flows.
Efficiency What are the costs, risks, and benefits?	Dollars per ton of salt removed	Desalination and evaporating return flows cost about $30 to $40 per ton of salt removed. Flow diversion costs about $10 to $100 per ton.
Equity How are costs, risks, and benefits distributed?	Who will pay?	Downstream users may pay disproportionate costs. Taxpayers will ultimately pay large percentages of costs for flow treatment. Taxpayers in other regions may pay disproportionate costs.
	Who will benefit?	Environmental values and interests will benefit. Upstream users may benefit by not being forced to control the sources of upstream uses which heavily contribute to downstream water problems.
Flexibility Adaptability to locational needs and changes over time	Reversibility	High capital costs of all alternatives make them essentially irreversible.
	Adaptability	The effectiveness of each alternative depends on suitability of location, particularly highly saline flows where major construction projects are feasible. Such locations appear limited on the Colorado River.
Implementability Adoptability and acceptability	Adoptability	Alternatives appear adoptable since legal and regulatory bases already exist.
	Acceptability	High capital costs and equity considerations are likely to generate substantial opposition to these alternatives. Flow containment and evaporation are particularly problematic since they will reduce total water supplies and could impair downstream water rights.

TABLE 5-9: SUMMARY AND COMPARISON OF WATER QUALITY ALTERNATIVES

CRITERIA	MEASURES	CONTROL POLLUTION SOURCES	TREAT SURFACE FLOWS
Effectiveness How much can water quality be improved?	Tons of salt and BOD removed per year	Improving irrigation efficiency, using water efficient crops, and improving conveyance systems can each remove 700,000 to 1,000,000 tons of salt per year in the Upper Colorado River Basin. Controlling municipal and energy sources of salinity is much less effective. As much as 13,000 tons of BOD can be removed by tertiary municipal treatment and improved holding pond design.	Desalination can remove up to one million tons of salt per year per plant in the Upper Colorado River Basin. Although flow diversion and evaporation are less effective, they both appear more effective than controlling municipal or energy facility sources.
	Risks of acute pollution	Improved holding pond design and pretreatment of effluents before release to ponds can reduce the risks of acute contamination of surface and groundwater from toxic substances.	Alternatives are primarily designed to reduce salinity.
Efficiency What are the costs, risks, and benefits?	Dollar costs per year per ton of salt removed	Alternatives for controlling runoff and erosion cost less than $70 per ton, except improved irrigation efficiency which costs about four times as much. Controlling municipal and energy facility sources of salt is much less efficient.	Costs of desalination and flow evaporation are comparable to costs of runoff and erosion control, about $30 to $40 per ton. Flow diversion costs range from $10 to $100 per ton.
	Environmental costs, risks, and benefits	Overall environmental effects of most alternatives are positive, especially for those which increase water availability. Some wetlands will be threatened by options for controlling runoff.	Overall environmental effects are negative because total water quantities are reduced, and large construction projects can alter natural and scenic beauty.
Equity How will costs, risks, and benefits be distributed?	Who will pay?	Taxpayers in general and particularly those in regions other than the West will pay disproportionate costs. This does not appear inequitable for control of energy facility pollution, since energy products will generally be exported from the West.	Taxpayers, particularly nonwesterners, will pay disproportionate costs.

TABLE 5-9: (Continued)

CRITERIA	MEASURES	CONTROL POLLUTION SOURCES	TREAT SURFACE FLOWS
Equity (Continued)	Ability and willingness to pay	Irrigated agriculture and towns impacted by energy resource development will generally be unable to afford these controls. Federal subsidies are increasingly opposed, and taxpayers are increasingly unwilling to pay.	Federal subsidies are increasingly opposed, and taxpayers are increasingly unwilling to pay.
	Who will benefit?	If the federal government pays the bill, municipal and environmental interests will benefit the most. Downstream users will benefit, adding to disputes among the Upper and Lower Basins of the Colorado.	Environmental interests and values will benefit. Upstream water users may benefit by not being forced to control pollution sources which heavily contribute to downstream water problems.
Flexibility Adaptability to locational needs and changes over time	Reversibility	Alternatives relying on management strategies are the most reversible, including erosion control, crop switching, and removing marginal lands from production. Other devices are essentially irreversible because of large capital expenses.	High capital costs make alternatives essentially irreversible.
	Adaptability	Most options are adaptable, except for pretreatment which is uncertain.	Suitable locations appear very limited on Colorado River.
Implementability Adoptability and acceptability	Adoptability	Improved control of municipal and agricultural sources of pollution requires substantial change in the regulatory system. Alternatives for controlling energy facility effluents are more adoptable.	Legal and regulatory basis for these alternatives is already established.
	Acceptability	Largest opposition can be anticipated from agricultural stakeholders.	High capital costs and equity consideration are likely to generate substantial opposition. Water availability problems associated with flow containment and cooperation may make these choices infeasible.

BOD = biochenical oxygen demand

Alternatives for controlling pollution from energy facilities, such as erosion control, pond design, and pretreatment of effluents, are among the least effective salinity-control measures. However, pond design improvements and pretreatment may be necessary in reducing the risks of pollution from toxic substances.

If cost effectiveness is considered, desalination and agricultural runoff control are comparable, generally costing less than $70 per ton of salt removed. The exception is improved irrigation efficiency, which costs about four times as much. Control of pollution from municipal and energy facility sources is considerably less cost-effective.

However, these two categories are not comparable if environmental quality and water availability are considered. Whereas most alternatives for controlling pollution sources increase water availability, just the opposite is true for surface flow treatments. Water availability considerations are particularly problematic for flow containment and evaporation which may, as a result, be infeasible in the Colorado River.

Both categories of alternatives raise serious equity questions, since many current users of water will be unable to afford the costs of increased control and, since federal subsidies are a virtual certainty for many options, costs to taxpayers can be expected to continue to rise. It is not clear how much of an increase would be associated with these alternatives. However, such increases cannot be viewed in isolation. In fact, when viewed as part of a larger trend of increasing costs for energy products, environmental protection, and cost of living in general, the costs of improved water quality control are likely to contribute to current resentment and rebellion on the part of taxpayers.

Many of these alternatives will also be constrained by difficulties in implementation and applicability. This is particularly true for capital-intensive alternatives which are generally irreversible. In addition to being capital-intensive, desalination will be constrained by suitability of locations. Improved control of municipal and agricultural sources of pollution may require substantial changes in the regulatory system, including incentives for operating treatment facilities more efficiently and changes in state appropriation systems to reduce the risks of new irrigation technologies.

In summary, this evaluation reinforces the commonly held notion that water quality considerations cannot be separated from those of water availability. There appears to be little evidence to suggest that any single alternative or category of alternatives considered in this chapter would be a successful response by itself to water quality concerns. For example, if the scarce water resources of the West are continually depleted, none of the alternatives considered here may be useful in preserving water quality.

Policymakers may choose to trade-off one set of problems for another; for example, choosing to limit agricultural production in many areas of the West in favor of energy resource development could reduce salinity problems but increase risks of more toxic pollution from energy production effluents. However, regardless of which kind of economic development is encouraged or discouraged and which policy alternatives are chosen, this evaluation suggests that many similar problems can be anticipated. These include increasing public expenditures for water quality control and increasing conflict among potential water users, among states of various water basins, and between the West and other regions.

CHAPTER 6

AIR QUALITY

EXECUTIVE SUMMARY

Conflicts between the goal of increased energy development and the goal of protecting the generally pristine air will continue to affect western energy resource development, especially development of the region's large coal and oil shale reserves. Recent years have witnessed a rapid expansion in exports of both raw western coal and electricity generated at western mine-mouth power plants. This boom was largely related to national energy policies to increase domestic energy production and federal air quality legislation which enhanced the demand for low sulfur coals. More recent changes in federal air quality regulations, especially prevention of significant deterioration (PSD) standards and "best available control technology" (BACT) requirements, are likely to reduce this coal boom as well as affect the development of oil shale. The complex and constantly changing set of federal and state air quality regulations are a vital concern to western interests, including both those who favor accelerated energy development and those who wish to see such development restricted.

Impacts

Air quality impacts from energy conversion facilities depend on several key technological and locational factors: type of energy facility and level of pollution control, labor requirements, resource characteristics, background levels of pollution, terrain features, proximity to pristine air quality areas, and meteorological conditions. The most important air quality impacts appear to be:

- Coal-fired electric power plants, even with 80 percent sulfur dioxide (SO_2) and 99 percent particulate controls, emit more SO_2, particulates, oxides of nitrogen (NO_x), and carbon monoxide on a per unit of energy output basis than any of the other technologies considered in this study. Hydrocarbon (HC) emissions from synthetic liquid fuel processes (coal and oil shale) can be high; for example, peak concentrations from a Synthoil liquefaction plant (100,000 barrels per day) in Colstrip, Montana are predicted to be 100 times higher than the 3-hour federal standard.

- Air emissions from Lurgi coal gasification, geothermal, oil and gas production, coal mining, and uranium mining and milling are relatively small; these technologies should not be significantly affected by current ambient air quality standards.

- In most cases, pollution concentration levels due to population increases can exceed those from the energy facilities even though emissions are usually only about ten percent of those produced by the energy facility. This occurs because population emissions, primarily from automobiles, are released close to the ground.

- Background levels of total suspended particulates, HC's, and oxidants (ozone), which apparently are from natural sources, have been measured near or above federal ambient standards in some areas of the West. Energy development could be restricted unless regulations take these naturally occurring conditions into account.

- In some areas, especially southern Utah and western Colorado, terrain features may limit energy development by contributing to high ground level concentrations of pollutants.

- PSD policies could limit energy development in the West by limiting plant sizes and siting choices. A 3,000 megawatt-electric (MWe) coal-fired power plant could have to be sited as much as 75 miles from a Class I PSD area in order not to exceed PSD increments.

- For the six site-specific scenarios analyzed, worst-case, short-term visibility reductions can range as high as 80 to 90 percent. On an average day, visibility would be reduced by about 8 percent in the vicinity of the six sites.

On a region-wide basis, emissions and resulting air quality problems will depend not only on energy development but also on other major emissions sources; e.g., smelters and urban areas. Based on one "nominal" level of development scenario, SO_2 emissions through 2000 were projected to increase nine-fold in the central mountain region and about 150 percent in the Northern Great Plains, and decrease 50 percent in the southwestern region. The large increase projected for SO_2 emissions in Colorado was due to coal and oil shale development, while in Arizona increased SO_2 emissions from coal-fired power plants were more than offset by tightened controls on copper smelting. By the year 2000, emissions of NO_x, for which effective controls are limited, were projected to increase 450 percent in the eight-state study area.

The Policy Context

Currently there is limited scientific understanding of the relationship between levels of air emissions and the resulting impacts on human health, property, and the natural environment. The lack of scientific agreement of what levels of pollution are acceptable or even which pollutants should be regulated has resulted in a continuing debate among industry, environmental interest groups, and policymakers. The policy system has responded to these conflicting pressures incrementally by modifying existing regulations and periodically adding new ones, resulting in a complex, overlapping, and sometimes contradictory regulatory structure.

Prior to the 1960's, government regulation of air quality was limited to the actions of a relatively few state and local governments. Because of increasing public concern with air pollution and the perception that state and local government responses were insufficient, federal authority increased throughout the 1960's, resulting in a major federal role mandated by the 1970 Clean Air Act (CAA) Amendments. This legislation required the Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS), but gave the states the major role in devising plans to meet these national standards. The 1977 CAA Amendments direct states to implement PSD regulations and emissions offset policies according to federal guidelines, leaving the federal government with primary control over new source performance standards (including BACT standards), hazardous pollutants, and mobile sources.

Air quality problems and issues, both of a substantive and of a procedural nature, are potentially one of the most limiting factors on western energy resource development. Issues which appear most critical are:

- BACT requirements could sharply reduce the short- and midterm demand for western coal. Since all flue gases will require scrubbing, it will be cheaper for many utilities, especially those in the central part of the U.S., to use medium and high sulfur local coals rather than import low sulfur western coals. For example, with a 90 percent sulfur removal standard, by 1990 Northern Great Plains coal production could drop to about half of what it would be with previous New Source Performance Standards. However, even with the BACT requirement, Northern Great Plains coal production will grow, and in 1990 can be expected to be at least four times greater than it was in 1975.

- The large number of mandated and potential Class I PSD areas in some parts of the eight-state study area and the complexities of the PSD regulations could block or slow western energy development activities.

- Emissions offset policy allows development in areas already violating NAAQS while PSD policies could significantly constrain economic development in the West.

- Conflicts over air quality policies have affected relations between the West and other coal producing regions, and among western states, the federal government, and Indian tribes (see box).

Policy Alternatives

In dealing with air quality problems and issues, policymakers will have to attempt to reconcile both energy and environmental policy objectives; that is, the overall policy objective is to protect air quality in the West while proceeding with the development of western energy resources. A variety of alternative policy responses are available for attempting to achieve this objective. Four specific alternatives within three categories are listed in Table 6ES-1. These categories suggest that policymakers can take an approach which emphasizes standards and regulations, technology and siting choices, and/or institutions and procedures. Although many other alternatives can be identified, the four listed in Table 6ES-1 were singled out to represent a range of possible approaches.

RECLASSIFICATION CONFLICT

The successful petition of the Northern Cheyennes to redesignate their reservation to Class I PSD status generated considerable controversy. According to the tribal Chairman, Allan Rowland, the redesignation does not mean the tribe is against progress. "For us progress means developing our environmental resources in renewable and compatible manners such as timber and agricultural products. They are the cores of our value system as people."

When the State of Wyoming objected to the redesignation citing possible restrictions on development in some parts of the state, Eric Metcalf, a Cheyenne spokesman, replied, "They're saying: 'We want to make decisions in our area, but you can't make those decisions for yours.'"

--"The Cheyennes Drive for Clean Air Rights." Business Week, April 4, 1977, p. 29

Findings

While the net result of any one of the alternatives is uncertain, each has the potential for contributing to the achievement of the policy objective. The first of the specific alternatives would define the BACT standard for SO_2 from large coal burning facilities as requiring 90 percent sulfur reduction regardless of coal characteristics and with an emission maximum of 1.2 pounds of SO_2 per million British thermal unit input. At the present time,

TABLE 6ES-1: AIR QUALITY POLICY ALTERNATIVES

CATEGORY OF ALTERNATIVES	SPECIFIC ALTERNATIVE
Modify Standards and Regulations	Define BACT for SO_2 emissions from coal combustion as 90% removal.
Alter Technological and Siting Choices	Construct smaller, dispersed energy conversion facilities. Increase commercialization programs for new, less polluting energy resource and conversion technologies.
Improve Procedural Mechanisms for Approving New Facilities	Establish a task force or other mechanisms for identifying future sites for energy facilities.

coal cleaning could be used to remove some sulfur prior to combustion to help meet the 90 percent sulfur removal requirements; however, with currently available technology some flue gas desulfurization (FGD) would still be necessary. The major conclusions from the evaluation of this alternative are:

- By 1995, relative to a base case representing a continuation of current standards, SO_2 emissions from power plants are projected to drop about 50 percent in the western region. However, even 1995 baseline emissions are relatively small (equal to 1976 levels despite a 132 percent increase in electricity production) due to strict state emission standards and PSD standards.

- The national policy objective of putting western, eastern, and interior coals back on a more competitive basis is achieved. One study projects almost a 50 percent drop by 1990 in western coal production relative to the base case; yet total western coal production is still projected to grow almost 175 percent from the 1975 level. However, these projections are highly uncertain, especially due to the unreliability of supply from unionized eastern mines, and the possibility of the increased costs causing a substitution of nuclear power for coal.

- By 1995, 90 percent sulfur control is projected to increase electricity prices by 3.5 percent above the base case in the western region. Due to "regulatory lag", utility investors will bear a measurable amount of these increased costs. The approach is inefficient in the sense that the same emission levels could be achieved more economically by giving incentives for using low sulfur coals.

- Implementation can be achieved directly under the 1977 CAA Amendments, but practical enforcement difficulties are created for EPA. It requires measuring sulfur removal percentages in addition to emission rates, and it requires monitoring of coal cleaning plants in addition to power plants.

Under the smaller, dispersed facilities option, instead of building one 1,500 MWe power plant, for example, industry would build three separate 500 MWe units sited far enough apart to avoid significant air emission interactions. This approach has no direct effect on emission levels, but by siting small facilities over a wide area, ground level air pollution concentrations would be lowered, thus hopefully reducing constraints on energy development resulting from ambient air quality or PSD regulations.

- The net effects on energy development levels are uncertain. By reducing the concentration of negative impacts (air pollution concentration levels, water consumption, and boomtown effects) more sites should be available and less difficulties encountered in siting each one. Also, lead times would be reduced from 9.5 - 12.0 years to 5.5 - 7.5 years. On the other hand, an increase in the number of sitings could make it more difficult to achieve a given energy goal.

- The net economic effects are uncertain but energy costs are likely to be higher. Capital and operating costs will be somewhat higher for smaller facilities; however, shorter lead times will reduce the costs of demand, forecasting errors and the financial burden of "construction work in progress". The effects on energy transportation costs will depend on many site-specific factors.

- Land use for plants will increase by a factor of 2 to 3. Transportation land use will be affected but, like economic costs, the direction and magnitude depends on many site-specific circumstances. Tax and other economic benefits would be distributed more evenly across the region.

- Because of uncertainties and the importance of site-specific factors, mandatory requirements for smaller, dispersed facilities are too inflexible. However, the option could be encouraged on a local basis by state utility commission's planning requirements or by federal agencies in environmental impact statement requirements.

The third alternative aims at commercializing new, less polluting technologies (e.g., coal gasification, in situ oil shale production, geothermal power production, etc.) earlier than might otherwise occur. This policy approach could be implemented by cooperative federal/state/industry programs for those technologies which appear most attractive for use in the West. Major points concerning this option are:

- If a commercialization program is successful, greater energy production could occur with less impact on air quality than created by power plants. All of the new energy technologies considered in this study produce fewer overall emissions per unit of energy produced than power plants.

- Economic costs are large: commercial scale synthetic fuel plants can cost $0.5-1.0 billion; geothermal demonstrations $50-100 million. Since the results could lead to a decision not to utilize large-scale commercialization, the economic risks are substantial.

- If successful, the benefits would accrue to the nation, the western region, and industry. Thus, to be equitable, costs would have to be shared among these groups.

- Implementation is likely to be difficult due to high economic costs and the need for close cooperation among federal agencies, western state governments, and industry.

Under the fourth alternative, each state in the eight-state study area would establish a task force which includes among its members representatives from the federal government, the state government, industry, and other interested parties (e.g., environmental groups, farmers, and ranchers, etc.). The goal of the task force would be to reach a consensus on future sites for major energy and other industrial facilities in order to eliminate or reduce siting delays. Such an approach has been undertaken in Utah through a task force formed by the governor's office. The primary conclusions for this alternative are:

- Although there will be no direct effect on emission rates, areas would be identified where the environmental consequences are less serious.

- By identifying and reaching a consensus on future sites for energy facilities, siting delays should be reduced. On the other hand, overall energy development levels could be restricted by limiting the number of sites available.

- Net effects on energy production costs are uncertain; they would be lowered by reducing siting delays but possibly increased due to higher costs for the sites agreed upon.

- Economic costs for the task force are generally small, unless extensive environmental studies are undertaken. It would be convened at the request of the governor or other official, and all interested parties will be given an opportunity to participate. No new institutions or laws are required.

Of course, these four specific alternatives are not mutually exclusive. Each (and/or others) could be implemented simultaneously with each making a contribution to the resolution of the problems and issues surrounding western energy development and air quality.

Conclusion

Along with water availability, air quality issues have a pervasive influence on western energy resource development. Air quality concerns will continue to directly affect which resources will be developed, the timing of that development, and the cost of the energy product. Air quality is also similar to water availability regarding the complexity of the regulatory system, which has attempted to reflect the multiple goals and values represented in energy and air quality concerns. The complex and constantly changing set of regulations and standards greatly increases the risks to energy developers and makes planning at all levels highly uncertain. A number of recent or potential legal changes, regulatory interpretations, or court decisions could substantially change the future role of western coal and other energy resources. For example, the BACT requirement in the 1977 CAA Amendments, in conjunction with regulations required by the 1976 Resource Conservation and Recovery act which will likely classify FDG sludge as hazardous waste, will put previously unforseen burdens on coal users. It is generally recognized that more stringent environmental regulations will require improved technologies, which will in turn increase the cost of energy. However, there is little evidence that policymakers have recognized or attempted to deal with problems created by the procedural requirements and uncertainties that now characterize air quality policy.

CHAPTER 6

AIR QUALITY

6.1 INTRODUCTION

Air quality regulations have and will continue to affect western energy resource development, especially development of the region's large coal and oil shale reserves.[1] National concerns about deteriorating air quality led to federal air quality regulations which made western coal an attractive alternative for reducing sulfur dioxide (SO_2) emissions. Installing flue gas desulfurization (FGD) units and using locally available higher sulfur coals was considered by many utilities to be a higher risk, more expensive way to meet federal SO_2 emissions standards. Together, these regulations and a national energy policy emphasizing increased reliance on domestic energy resources, especially coal, led to a boom for western coal and increased exports of both raw coal and electricity generated by coal-fired power plants located at or near western coal mines.

More recent changes in federal air quality regulations promise to dampen this coal boom as well as affect the development of oil shale. For example, regulations to prevent significant deterioration of air quality in areas where air quality is high can limit the production of synfuels and electricity within the region. Policies requiring the use of the best available control technology (BACT) on all new facilities and promoting the use of local coals, even when they have a high sulfur content, can also lessen the demand for western coal.

In large part the policy debate over air quality, both nationally and regionally, revolves around a complex and constantly changing set of federal and state regulations. Federal and certain more stringent state standards will play a key role in influencing the rate, location, and type of technology used in producing energy from western coal and oil shale. These regulations are a vital concern to western interests, both those who favor accelerated energy development and those who wish to see such development blocked.

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[1] The other four resources addressed in this study (i.e., uranium mining and milling, geothermal, oil, and natural gas) have much less of an impact on air quality, and thus, their development is not likely to be affected in any major way by air quality regulations. For this reason, this chapter focuses on coal and oil shale.

The remainder of this chapter is divided into two major sections. The first of these (Section 6.2) identifies and discusses major air quality problems and issues. This section includes a summary description of the air quality impacts[1] of western energy resource development and a description of the social and political context within which these problems and issues either have arisen or can be expected to arise. The second major section (6.3) focuses on alternative policies and strategies for achieving energy and air quality policy objectives. This section includes the identification of these objectives and the identification, evaluation, and comparison of several alternative policies and implementation strategies for achieving these objectives

6.2 AIR QUALITY PROBLEMS AND ISSUES

6.2.1 Technological and Locational Factors Affecting Air Quality Impacts

The extent and type of air quality impacts resulting from the conversion of energy resources can vary significantly depending upon which energy development technologies are used and where they are sited. As indicated in our impact analysis reports,[2] air emissions, emissions controls, and labor requirements are technological factors which can cause the greatest variation in air quality impacts. Resource characteristics (such as sulfur content of coal), background levels of pollutants, terrain, dispersion potential, and the proximity of energy facilities to pristine air quality areas (such as national parks) are key locational factors. The air quality impacts resulting from energy development will depend very largely on how these technological and locational factors are combined as western energy resource development proceeds.[1]

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[1] See White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[2] For a further discussion of these factors, see White et al. Progress Report, Vol. I, Chapter 3; and White, et al. Impact Analysis Report. See the "Introduction" to this report for a description of the states, resources, and types of facilities considered in this study.

A. Air Emissions and Emissions Controls

Coal-fired steam-electric power generating facilities emit more SO_2, particulates, oxides of nitrogen (NO_x), and carbon monoxide (CO) on a per Btu (British thermal unit) of energy product basis than any of the other technologies considered in this study (see Tables 6-1 and 6-2). These data are based on analyses which assumed 80 percent SO_2 and 99 percent particulate removal for the power plant. If no SO_2 controls were installed, power plant SO_2 emissions would be about five times as large. Hydrocarbon (HC) emissions from Synthoil coal liquefaction and TOSCO II oil shale facilities are generally higher than those from power plants. Conventional oil and gas extraction produces few residuals, although HC emissions for natural gas production are relatively high. Enhanced oil recovery using steam generated by burning high-sulfur oil and geothermal electric power generation also emit relatively high levels of sulfur, which in the case of geothermal is in the form of hydrogen sulfide (H_2S).[2] Emissions levels from coal and uranium mining are negligible, although blowing dust can be a problem in some periods.

B. Labor Requirements

The relatively large labor requirements for constructing and operating energy facilities will lead to large, rapid population increases in nearby rural western communities.[3] In some cases, this increased population can result in peak ground level concentrations of particulates, SO_2, and HC (primarily from automobiles and home heating) that exceed those from the energy facilities themselves. This can occur even though the total emissions from

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[1] For an indication of how impacts can vary when the same technology is sited at different locations, see White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. I, Chapter 3; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[2] Neither enhanced oil or geothermal were analyzed on a site-specific basis, primarily because available data are so limited. The numbers reported in Table 6-1 are for a representative development, and in the case of geothermal, include 90 percent efficient H_2S removal. Technologies with an efficiency of 99.9 percent are available for removing H_2S.

[3] See Chapters 8 and 9 for a description of some of the major population impacts resulting from energy development.

TABLE 6-1: AIR EMISSIONS FOR STANDARD SIZE ENERGY FACILITIES[a] (pounds per hour)

CONVERSION FACILITY	PARTICULATES	SO_2[b]	NO_x	HC	CO
Coal					
Power Plant (3,000 MWe)[c]	1,110 - 5,020	5,800-14,000	14,320-35,140	400 - 650	1,330 - 2,180
Lurgi Gasification (250 MMscfd)	N[d]	520	650	47[d]	N
Synthane Gasification (250 MMscfd)	8[d]	3,520	5,050	94[d]	180
Synthoil Liquefaction (100,000 bbl/day)[c]	480 - 1,250[e]	940-1,170	4,620-5,770	1,350 - 1,690	180 - 230
Surface Mine (12 MMtpy)	13 - 24	8-16	0.5-210	17 - 180	13 - 87
Oil Shale[f]					
TOSCO II Oil Shale[f] (50,000 bbl/day)	860	350	1,900	1,020	80
Underground Oil Shale Mine (26 MMtpy)	125	N	270	54	480
Modified *In Situ* Oil Shale Processing (57,000 bbl/day)	74	174	588	120	84
Modified *In Situ* Oil Shale Processing[g] with Surface Retort (57,000 bbl/day)	362	343	1,777	130	U
Crude Oil					
Conventional Oil Extraction (50,000 bbl/day)	0.3	21.7	17.6	4.3	1.3
Enhanced Oil Extraction Steam Injection (100,000 bbl/day)	358-1,187	10,125	308	108	208
Enhanced Oil Extraction CO_2 Miscible (100,000 bbl/day)	120	3,420	1,040	35	70
Natural Gas					
Natural Gas Production/ Processing (250 MMscfd)	2	468	655	1,000	2
Uranium					
Underground Mine (1,100 mtpd ore)	0.16	0.36	5	0.5	3
Surface Mine (1,100 mtpd ore)	361	8.9	123	U	93.4
Mill (1,000 mt yellowcake per year)	40	1.03	0.3	0.05	U
Solutional Mine-Mill (250 tons yellowcake per year)[h]	N	N	N	N	N
Geothermal (100 MWe)	NA	210[i]	NA	NA	NA

SO_2 = sulfur dioxide
NO_x = oxides of nitrogen
HC = hydrocarbons
CO = carbon monoxide
MWe = megawatt-electric
MMscfd = million standard cubic feet per day
N = negligible

bbl/day = barrels per day
MMtpy = million tons per year
U = unknown
CO_2 = carbon dioxide
mtpd = metric tons per day
mt = metric ton
NA = not applicable

TABLE 6-1: (Continued)

[a] These numbers represent the range of emissions found in the site-specific scenarios; and facilities are assumed to be operating at a full load.

[b] Had scrubbers not been hypothesized for the power plants, these numbers would be about five times larger.

[c] 99 percent particulate removal and 80 percent SO_2 removal.

[d] These values do not include fugitive particulates or fugitive HC.

[e] This value does not include fugitive particulates.

[f] No range is available for oil shale because the processes were hypothesized at only one site.

[g] Assumes mined-out shale is processed by surface retorting facility.

[h] Emissions from the solutional uranium mine mill consist of ammonium, ammonium chloride, and uranium oxide.

[i] This number is for hydrogen sulfide (H_2S) and assumes 90 percent H_2S removal.

TABLE 6-2: AIR EMISSIONS ON AN EQUIVALENT ENERGY BASIS (pounds per 10^6 Btu in product)[a]

CONVERSION FACILITY	PARTICULATES	SO_2[b]	NO_x	HC	CO
Coal					
Power Plant[c]					
Btu (electric)	0.11 - 0.50	0.57 - 1.37	1.40 - 3.43	0.04 - 0.06	0.13 - 0.21
Btu (thermal	0.04 - 0.17	0.20 - 0.48	0.49 - 1.20	0.01 - 0.02	0.04 - 0.07
Lurgi Gasification	N	0.05	0.06	0.004	N
Synthane Gasification	0.001	0.34	0.48	0.01	0.02
Synthoil Liquefaction	0.02 - 0.05	0.04 - 0.05	0.20 - 0.25	0.06 - 0.07	0.01
Surface Mine	0.001	0.001	N - 0.01	0.001-0.008	0.001-0.004
Oil Shale[d]					
TOSCO II Oil Shale[d]	0.08	0.03	0.17	0.09	0.01
Underground Oil Shale Mine	0.006	N	0.01	0.003	0.02
Modified *In Situ* Oil Shale Processing	0.006	0.01	0.04	0.009	0.006
Modified *In Situ* Oil Shale Processing with Surface Retort[e]	0.03	0.03	0.14	0.01	U
Crude Oil					
Conventional Crude Oil Extraction	N	0.002	0.001	N	N
Enhanced Crude Oil Extraction Steam Injection	0.02 - 0.05	0.5	0.01	0.005	0.01
Enhanced Crude Oil Extraction CO_2 Miscible	0.005	0.15	0.04	0.001	0.003
Natural Gas					
Natural Gas Production/ Extraction	N	0.05	0.07	0.10	N
Uranium					
Underground Mine	N	N	0.0001	N	N
Surface Mine	0.01	0.0003	0.004	U	0.003
Mill	0.001	N	N	N	N
Solutional Mine-Mill[f]	N	N	N	N	N
Geothermal					
Btu (electric)	NA	0.61[g]	NA	NA	NA
Btu (thermal)	NA	0.21[g]	NA	NA	NA

Btu = British thermal units
SO_2 = sulfur dioxide
NO_x = oxides of nitrogen

HC = hydrocarbons
CO = carbon monoxide
N = negligible

U = unknown
CO_2 = carbon dioxide
NA = not applicable

TABLE 6-2: (Continued)

[a] These numbers represent the range of emissions found in the site-specific scenarios; and facilities are assumed to be operating at a full load. Equivalent energy values are based on the Btu/year for the stan- dard size for each facility. These are, in Btu/year: power plant, 6.73 X 10^{13} (Btu electric), 1.92 X 10^{14} (Btu thermal); gasification processes and natural gas, 8.21 X 10^{13} ; liquefaction, 1.84 X 10^{14} ; TOSCO II oil shale, 8.87 X 10^{13} ; *in situ* oil shale, 1.01 X 10^{14} ; conventional crude oil, 9.198 X 10^{13} ; underground oil shale mine, 1.67 X 10^{14} ; uranium mine-mill, 2.99 X 10^{14} ; coal mine, 1.92 X 10^{14} ; geothermal, 2.24 X 10^{12} (Btu electric), 6.4 X 10^{12} (Btu thermal).

[b] Had scrubbers not been hypothesized for the power plants, these numbers would be about five times larger.

[c] 99 percent particulate removal and 80 percent SO_2 removal.

[d] No range is available for oil shale because the processes were hypothesized at only one site.

[e] Assumes mined-out shale is processed by surface retorting facility.

[f] Emissions from the solutional uranium mine-mill consist of ammonium, ammonium chloride, and uranium oxide.

[g] This number is for hydrogen sulfide (H_2S) and assumes 90 percent H_2S removal.

urban sources are usually only about ten percent of these produced by the energy facility, because the urban emissions are released close to the ground where little mixing or dilution takes place.

C. Resource Characteristics

As shown in Table 6-3 the heat and sulfur content of western coals varies considerably with location. Although all of the coals have a "low" sulfur content on a percent weight basis, on a Btu basis, the SO_2 emissions from coals which have low heating values are not necessarily low. For the six cases in Table 6-3 only three would meet existing federal new source performance standards (NSPS) of 1.2 pounds (lbs) of SO_2 per million Btu input if 20 percent of the sulfur were retained in the ash.[1] Thus, some type of sulfur control system would be required on some power plants burning western coals even if it were not for the fact that many western states have SO_2 emissions lower than the federal standard or for the BACT requirement of the 1977 Clean Air Act (CAA) Amendments. In addition, the low heating values of many western coals would require larger volumes of coal to be burned and could increase plant costs by as much as $49-74 per kilowatt hour (kWh)(1976 dollars).[2]

D. Background Pollutant Levels

In some areas of the West, background levels of total suspended particulates (TSP), HC, and ozone, which apparently are a product of natural sources, have been measured at or above federal ambient standards. TSP are largely due to windblown dust composed of large particle-sized inorganic materials not considered a health hazard by the Environmental Protection Agency (EPA).[3] Background concentrations of HC, apparently from

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[1] For the site-specific impact analyses, it was assumed that none of the sulfur was retained in the ash.

[2] Crenshaw, John, et al. Alternatives for Revising the SO_2 New Source Performance Standard for Coal-Fired Steam Generators, Staff Study. Research Triangle Park, N.C.: U.S., Environmental Protection Agency, Office of Air Quality Planning & Standards, Strategies & Air Standards Division, Energy Strategies Branch, 1976.

[3] U.S., Department of the Interior, National Park Service, Denver Service Center. Analysis of Kaiparowits: Powerplant Impacts on National Recreation Resources. Denver, Colo.: Denver Service Center, 1976, p. 44; and "EPA Reports Progress in Controlling Air Pollution." Journal of the Air Pollution Control Association, Vol. 27 (November 1977), p. 1129.

TABLE 6-3: HEAT AND SULFUR CHARACTERISTICS OF SELECTED WESTERN COALS

SITE	SULFUR CONTENT (percent by weight)			Btu CONTENT (Btu per pound)		SO_2 EMISSION RATE[a] (pounds of SO_2 per million Btu)	
	AVERAGE	RANGE	PROJECTED FOR SCENARIO	AVERAGE	RANGE	20-PERCENT SULFUR RENTENTION	0-PERCENT SULFUR RETENTION
Kaiparowits[b]	.52	0.2-1.4	.5	10,800	10,600-11,000	.74	.93
Farmington[c]	.78	0.6-0.9	.7	8,580	7,930-9,525	1.49	1.86
Rifle[d]	.50	0.4-0.7	.6	11,220	10,830-11,410	.71	.89
Gillette[d]	.62	0.3-0.9	.6	7,980	7,240-8,540	1.20	1.50
Colstrip[d]	.80	0.3-1.8	.8	8,870	6,870-9,500	1.44	1.80
Beulah[d]	.60	0.4-1.1	.8	7,070	6,830-7,280	1.36	1.70

Btu = British thermal units SO_2 = sulfur dioxide

[a] The range of emission in this table reflects variations in the amount of sulfur retained in the ash. This retained sulfur does not form SO_2. Sulfur retention in the combustion of western coals is generally higher than for eastern coals, but the amount of retention is variable. For additional descriptions, see White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. II, Chapters 6-11; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[b] U.S., Department of the Interior, Bureau of Land Management. Final Environmental Impact Statement: Proposed Kaiparowits Project, 6 vols. Salt Lake City, Utah: Bureau of Land Management, 1976.

[c] U.S., Department of the Interior, Bureau of Reclamation. Western Gasification Company (WESTCO) Coal Gasification Project and Expansion of Navajo Mine by Utah International Inc., San Juan County, New Mexico: Final Environmental Statement, 2 vols. Salt Lake City, Utah: Bureau of Reclamation, 1976.

[d] Ctvrtnicek, T.E., S.J. Rusek, and C.W. Sandy. Evaluation of Low Sulfur Western Coal Characteristics, Utilization, and Combustion Experience, EPA-650/2-75-046, Contract No. 68-02-1302. Dayton, Ohio: Monsanto Research Corporation, 1975.

trees and bushes, have sometimes exceeded federal ambient standards in northwestern Colorado.[1] Energy development in the eight-state study area may be restricted by these high background levels unless regulations take these conditions into account. Apparently, EPA and some states are moving in this direction, particularly in the case of particulates, ozone, and HC.

E. Terrain Characteristics and Meteorological Conditions

In some areas of the West, terrain characteristics and meteorological conditions may limit energy development by contributing to high ground-level concentrations of pollutants. Plume impactions occur when stack plumes flow into elevated terrain such as is found in southern Utah and western Colorado. This is most likely to occur when atmospheric mixing is low (wind speeds of less than 5 to 10 miles per hour, clear sky, and in the predawn hours). Temperature inversions occur when air temperature increases with altitude, thereby inhibiting vertical mixing and the dispersion of air pollutants. The frequency of inversions varies both seasonally and geographically throughout the eight-state study area. When plume impaction or temperature inversions occur, ground-level concentrations of pollutants can quickly exceed ambient air quality or Prevention of Significant Deterioration (PSD) Standards.

F. Proximity to Pristine Areas

A policy to prevent significant deterioration of air quality in pristine areas (such as national parks) may prevent conversion facilities from being sited close to these areas and may limit the size of facilities that can be sited. This can limit development, especially if pristine areas are widespread or occupy large amounts of land (as in southern Utah). Our air quality modeling results indicate that coal-fired power plants of 3,000 megawatt-electric (MWe) would have to be sited up to 75 miles from Class I areas in order not to exceed PSD increments specified in the 1977 CAA Amendments.[1]

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[1] Rasmussen, Reinhold A. "What Do the Hydrocarbons From Trees Contribute to Air Pollution?" Journal of the Air Pollution Control Association, Vol. 22 (July 1972), pp. 537-543. The high background levels of ozone found in some parts of the West have not been explained. See, for example, Berry, W.T., and R.E. Amber. "Report on the Fifth APCA Government Affairs Seminar: 'A New Look at the Old Clean Air Act.'" Journal of the Air Pollution Control Association, Vol. 27 (June 1977), p. 529.

6.2.2 Site-Specific and Regional Air Quality Impacts

As noted earlier, the air quality impacts of western energy resource development can vary considerably depending upon how the technological and locational characteristics discussed above are combined. To analyze these combinations, we considered six site-specific scenarios chosen to be representative of the combination of these factors which can be expected when western energy resources are developed. Table 6-4 lists the percentage of sulfur removal which would be required and identifies the limiting standard for coal-fired power plants to meet all federal and state standards at each of the six scenario sites. These results suggest that facilities in Wyoming, New Mexico, and possibly Montana are likely to have the fewest air quality problems since applicable federal and state standards can be met in these three states with the least percentage removal of SO_2. But in none of the six cases can all federal and state standards be met without the use of some SO_2 emission control with an overall removal efficiency of around 80 percent.

Locating facilities in southern Utah and western Colorado will present the greatest problems unless removal percentages are quite high. In Colorado, this is largely due to state SO_2 standards and, to some extent, the nature of the terrain in western Colorado. A combination of factors affect air quality in southern Utah where poor dispersion potential and complex terrain could result in violation of Class II PSD increments as well as the violation of Class I PSD areas close to the development site.

Visibility in the vicinity of development facilities will also be affected. Table 6-5 shows the worst-case, short-term visibility effects that would result from a conversion rate of SO_2 to sulfates of 1 percent per hour for the six site specific scenarios considered. As the data show, these reductions can be quite high (80 to 90 percent) in many cases. These worst-case meteorological conditions can be expected to occur a few times each year. An analysis of average visibility reduction for the six site-specific scenarios shows about an 8 percent drop; that is, on an average day, visibility will be reduced 8 percent.

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[1] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 685. The distance of a facility must be sited from a pristine area varies with the type of facility and locational factors. Distances range from 5-75 miles for the facilities studied and are largest for coal-fired power plants. For more details, see White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

TABLE 6-4: SULFUR REMOVAL EFFICIENCIES REQUIRED FOR COAL-FIRED POWER PLANTS TO MEET ALL FEDERAL AND STATE SULFUR DIOXIDE STANDARDS

STATE	SULFUR REMOVAL REQUIRED (%)	GOVERNING REGULATION
Colorado Rifle 1,000 MW and mine	96.2	State Category II Ambient
Montana Colstrip 3,000 MW and mine	Maximum control capability State NSPS technically practicable and economically feasible as determined by Air Quality Bureau 80	Federal 24 hr. Class II PSD
North Dakota Beulah 3,000 MW and mine	85	Federal 24 hr. Class II PSD
New Mexico Farmington 3,000 MW and mine	78	Federal 24 hr. Class II PSD
Utah Escalante 3,000 MW and mine	94	Federal 24 hr. Class II PSD
Wyoming Gillette 3,000 MW and mine	82	State NSPS

MW = megawatt
NSPS = New Source Performance Standards
hr. = hour
PSD = prevention of significant deterioration

On a region-wide basis, emissions and air quality problems will depend not only on the scale and character of energy development, but also on the level of development and level of pollution control for other major emission sources, e.g., smelters and refineries. Figure 6-1 shows projected levels of SO_2 emissions nationally and in the eight-state study area through the year 2000 for the highest level of coal and oil shale development considered in

TABLE 6-5: WORST-CASE, SHORT-TERM VISIBILITY IMPACTS

FACILITY[a]	SITE	BACKGROUND VISIBILITY (miles)	WORST-CASE SHORT-TERM VISIBILITY[b] (miles)	PERCENT VISIBILITY REDUCTION
Coal-fired power plant	Kaiparowits Rifle	70 60	8.6 43.6	87.7 27.3
Coal-fired power plant and mine	Gillette Beulah	70 60	9.6 4.8	86.3 92.0
Lurgi gasification and mine	Farmington Gillette	60 70	41.6 48.4	30.7 30.9
Synthane gasification and mine	Gillette Colstrip	70 60	59.5 48.9	15.0 18.5
Synthoil liquefaction and mine	Gillette	70	48.8	30.3
TOSCO II oil shale	Rifle	60	44.4	26.0
Lurgi and Synthane gasification, coal-fired power plants, and mines	Farmington Colstrip	60 60	9.3 8.1	84.5 86.5
Coal-fired power plants, Lurgi gasification, and mines	Colstrip	60	8.7	85.5
Lurgi and Synthane gasification, Synthoil liquefaction, coal-fired power plant and mines	Farmington	60	8.2	86.3
Lurgi gasification and mine (2 plants)	Beulah	60	37.4	37.7
Synthane gasification and mine (2 plants)	Beulah	60	29.4	51.0

Source: White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[a] Facilities modeled are 3,000 megawatt-electric (MWe) coal-fired power plants, (except for Rifle, where a 1,000 MWe plant was modeled), 250 million cubic feet per day (MMcfd) Lurgi gasification, 250 MMcfd Synthane gasification, 100,000 barrels per day (bbl/day) Synthoil liquefaction, 50,000 bbl/day TOSCO II oil shale and the associated mine. The power plants were modeled with 99 percent removal of particulates and 80 percent removal of sulfur dioxide (SO_2).

[b] Short-term visibility impacts were investigated using a "box-type" dispersion model. This particular model assumes all emissions occuring during a specified time interval are uniformly mixed and confined in a box capped by a lid or stable layer aloft. A lid of 500 meters has been used through the analyses. The conversion rate of SO_2 to sulfur was assumed to be 1 percent per hour.

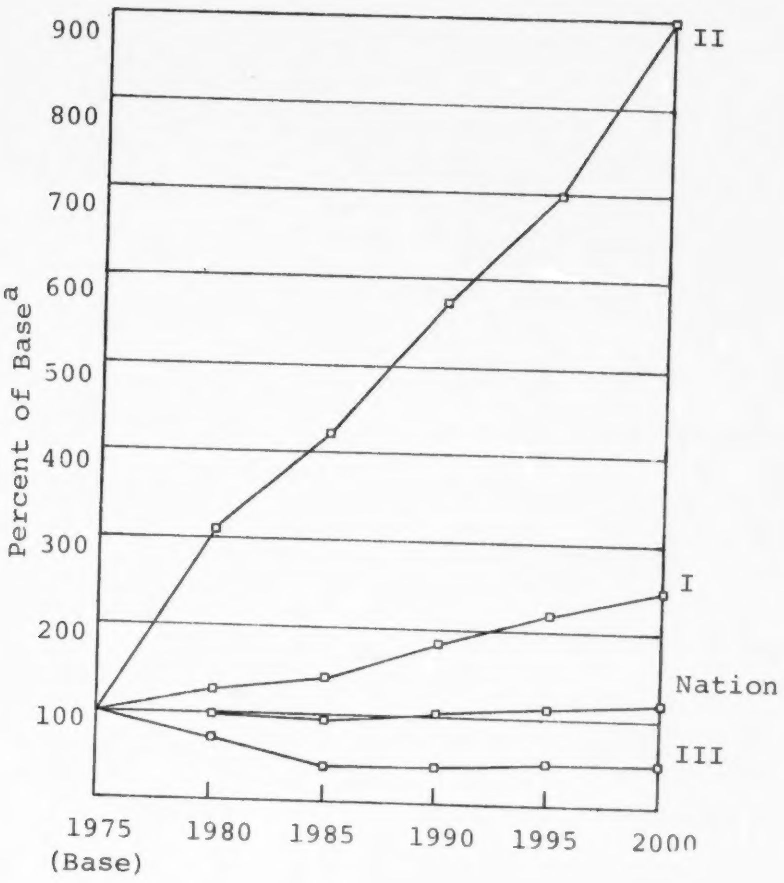

FIGURE 6-1: GROWTH OF SULFUR DIOXIDE EMISSIONS IN THE NOMINAL DIRTY SCENARIO[b]

[a] 1975 base sulfur dioxides were as follows: Nation, 28.17 million tons per year; Subregion I (Montana, North Dakota, and South Dakota), 379.7 thousand tons per year (Mtpy); Subregion II (Colorado and Wyoming), 154.1 Mtpy; and Subregion III (New Mexico, Arizona, and Utah), 2,883.0 Mtpy.

[b] The Nominal Dirty scenario assumed 4.2 million bbl/day of shale oil by the year 2000 rather than the 2.5 million bbl/day assumed in the SRI Nominal scenario. Emission factors were then collected for SEAS; emission control assumptions correspond to pre-1977 State Implementation Plans, with NSPS becoming effective in 1979, except Arizona, Colorado, New Mexico, Utah and Wyoming, where stricter state standards apply after 1979.

this study[1] (see the footnotes for Figure 6-1). While emissions of SO_2 through the year 2000 are projected to increase nine-fold in the Central Mountain region and 149 percent in the Northern Great Plains, they grow only by 18 percent for the nation as a whole and are cut in half in the Southwestern states. The SO_2 emissions in Colorado grow substantially due to development of coal and oil shale. In Arizona, however, increased emissions from coal-fired electrical generation are more than offset by tightened controls on copper smelting, the source of 93 percent of 1980 SO_2 emissions. Although not shown in Figure 6-1, of the five air pollutants studies, NO_x emissions are projected to have the greatest relative increase in the eight-state study area, reaching 450 percent of the 1975 level by the year 2000.

Long-range transport of sulfates and fine particulates could extend pollution problems over considerable distances from energy facilities, and air quality outside the eight-state study area could be adversely affected. Although the extent to which long-range transport will occur is not known, regulations to resolve air pollution problems across political jurisdictions will almost certainly add to intergovernmental conflicts over air quality control.

Changes in precipitation due to local weather modification caused by energy facilities may occur, particularly if several facilities are sited close together. However, current knowledge is inadequate to support conclusions about the probability and extent of this impact.

6.2.3 The Social and Political Context of Air Quality Issues in the West

As indicated in Chapter 1, public concern about air quality problems changed significantly in the 1960's. By 1970 a majority of Americans considered air pollution to be one of our two most important domestic problems.[2] Public concern largely resulted from a growing awareness of the effects of air pollution on human health, property, and the natural environment. This concern increased public support for greater governmental control of air pollutant emissions and protection of ambient air quality. This has led to a still evolving web of laws, regulations, and court interpretations which is at once complex and controversial. And in no area of the country is the controversy greater than in the West.

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[1] These data were developed using EPA's Strategic Environmental Assessment System (SEAS) Model. See Ball, Richard H., Project Officer. A Description of the SEAS Model. Washington, D.C.: U.S., Environmental Protection Agency, October 1977. Also see White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming, Chapter 11, Regional Impacts, for a more extended discussion of this analysis.

[2] See Jones, Charles O. Clean Air: The Policies and Politics of Pollution Control. Pittsburgh, Pa.: University of Pittsburgh Press, 1975, pp. 144-45.

At the outset, it is important to note that current knowledge of the relationship between given levels of air emissions and the resulting impacts on human health, property, and the natural environment is limited. The lack of scientific agreement on acceptable levels of pollution or even on which pollutants should be regulated has resulted in a continuing debate among industry, environmental interest groups, and policymakers.

In the absence of a complete understanding of the relationship of air pollutant emissions and air quality impacts, the debate over air quality policy tends to polarize. On the one hand, there are those who argue that the prudent thing to do given this uncertainty is to set very strict standards which ensure that we do not do irreversible damage to human health and the environment. On the other hand, there are those who argue that we should not pay the high economic and regulatory costs resulting from strict regulation until we know that they are, in fact, needed. In short, positions in the debate over air quality are based as much on value positions and perspectives as on knowledge.

As the following description indicates, the policy system has responded to these conflicting pressures incrementally by modifying existing regulations and periodically adding new ones. This has produced a complex of overlapping, sometimes contradictory regulations which makes it possible for some elected officials in the West to view the existing regulatory system as a barrier to the region's economic development while others believe that the same system provides inadequate protection. And it is clear that this complex system of air quality regulations offers a convenient vehicle for those who wish to challenge western energy resource development--even when their challenge zeros in on air quality regulations as a convenient surrogate for some other concern.

The remainder of this section will briefly describe how the current regulatory system has evolved, identify and describe current regulations, and identify some of the major problems and issues which arise because of conflicts between air quality and western energy resource development.

A. Historical Development of Air Quality Regulations

The existing federal air quality regulatory system was initiated in 1955 when the Congress authorized the expenditure of $5 million annually for 5 years to support federal air quality research and provide assistance to the states and educational institutions for research, demonstrations, and training[1] (see Table 6-6). While providing limited federal support, the 1955 legislation was essentially a problem-defining mechanism in that it "...provided assistance in determining the nature of the problem to be regulated by state and local agencies."[2] Prior to 1955, governmental responsibility for controlling air pollution had been assumed by a number of state and local governments. An ordinance adopted by the Chicago City Council in 1881 was the first air pollution law in the U.S.[3] Other examples of local and state government action are establishment of the Los Angeles County Air Pollution Control Agency in 1948 and passage of the first state air pollution legislation by Oregon in 1952.

The 1955 federal act must be considered in the context of some state and local governments already having acted to combat and control air pollution. This act was considered necessary, however, since state, local, and regional variations made it difficult to develop and enforce standards, and because air pollutants do not honor political boundaries.

The next major federal law was the CAA of 1963, which provided "...that the prevention and control of air pollution at its source is the primary responsibility of states and local governments...". However, this act also noted "...that federal financial assistance and leadership is essential for the development of cooperative Federal, State, regional, and local programs to prevent and control air pollution."[4]

It was this new policy statement which laid the basis for federal initiative in air pollution control. The Secretary of Health, Education, and Welfare (HEW) was authorized to act when air pollution that originated or was discharged in one state affected the health or welfare of persons in another state. Federal interstate abatement actions were provided for, provisions which "...were only opening wedges for the federal government."[5] The 1963 CAA continued grants to state and local control agencies, but,

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[1] Air Pollution Control Act, Pub. L. 84-159, 69 Stat. 322 (1955).

[2] Jones, Charles O. "Federal-State-Local Sharing in Air Pollution Control." Publius, Vol. 4 (Winter 1974), p. 73.

[3] Davis, J. Clarence, III. The Politics of Pollution. New York, N.Y.: Pegasus, 1970, p. 33.

[4] Clean Air Act of 1963, Pub. L. 88-206, 77 Stat. 392.

[5] Jones, Charles O. Clean Air: The Policies and Politics of Pollution Control. Pittsburgh, Pa.: University of Pittsburgh Press, 1975, p. 76.

TABLE 6-6: CHRONOLOGY OF MAJOR FEDERAL AIR QUALITY LAWS AFFECTING ENERGY DEVELOPMENT

DATE	LAW	SIGNIFICANT PROVISIONS AND AUTHORITY
1955	Air Pollution Control Act, Pub. L. 84-159, 69 Stat. 322	Authorized Public Health Service to conduct a research program and give technical assistance to state and local governments.
1963	Clean Air Act, Pub. L. 88-206, 77 Stat. 392	Authorized direct grants via U.S. Department of Health, Education, and Welfare to state and local governments for control programs, and provided for federal enforcement action in interstate pollution cases. Designated research into (1) control of motor vehicle exhaust, (2) removal of sulfur from fuels, and (3) the development of air quality criteria (description of the major pollutant effects on health and property) to serve as guidelines for agencies in establishing source-emission limits and ambient air quality standards.
1967	Air Quality Act, Pub. L. 90-148, 81 Stat. 485	Established a sequence of criteria, standards, and enforcement; required the designation of air quality control regions; authorized federal interstate air quality planning agencies if states fail to act; required states to establish ambient standards along federal guidelines; expanded research and development for pollution control of fuel combustion and automobiles, mobile source standards to be set by federal government; authorized a study of national emission standards (including economic impact).
1970	Clean Air Act Amendments, Pub. L. 92-604, 84 Stat. 1676, 42 U.S.C. § 7401 et seq.	Provided stronger federal direction in setting standards, speeding up implementation, and assuring enforcement; established procedures for setting primary (health) and secondary (welfare) national ambient air quality standards; gave Environmental Protection Agency (EPA) responsibility of implementing provisions of the Act.
1977	Clean Air Act Amendments, Pub. L. 95-95, 91 Stat. 685	Relaxed deadlines of Clean Air Act (1970) for mobile sources; clarified the prevention of significant deterioration (PSD) by setting up a three class system for the country and a definition of available control technology for new or modified sources; endorsed EPA's emissions offset policy for nonattainment areas; provided for restrictions for use of only local coal to prevent severe economic disruption or unemployment; provided for investigation into standards for hazardous pollutants.

for the first time, the federal government was empowered to take legal action in its attempt to terminate air pollution.

The Air Quality Act of 1967[1] expanded federal authority and called for both emissions and ambient air quality standards to be established and air pollution control regions to be designated. As provided for in the 1967 legislation, both the state and the federal government were responsible for setting standards. The Secretary of HEW was directed to identify and define "air quality control regions" on the basis of meteorological and urban factors. Within these air quality regions, states were to adopt and implement ambient air quality standards subject to approval on the basis of federally-established criteria. Both the standards and the state implementation plans (SIP's) were subject to federal approval. Following the approval of its standards and SIP, a state was to assure the federal government that the standards and implementation plan would be adhered to. If the state's program was found to be inadequate, the Secretary of HEW was empowered to establish new standards and a new SIP to be followed by the states. Whereas the 1963 act "...had encouraged and invited the development of regionally based air pollution control programs, the 1967 Act insisted on it."[2]

The authorization for the 1967 Air Quality Act expired in 1970. To remedy this situation and to correct many deficiencies in the 1967 law, Congress legislated an additional set of CAA Amendments.[3] A fundamental reason for the additional legislation was the weak implementation mechanisms under the Air Quality Act of 1967. By 1970, no state had successfully completed all the requirements necessary for the enactment of a federally-approved air pollution control program.[4]

The CAA Amendments of 1970 established a comprehensive air quality regulatory program. Under these amendments, the Administrator of the EPA was to establish national primary and secondary ambient air quality standards. States were to carry out federally-approved implementation plans for achieving these standards. The EPA Administrator was also given authority to set performance standards for new stationary sources, as well as national emission standards for hazardous air pollutants.

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[1] Air Quality Act of 1967, Pub. L. 90-148, 81 Stat. 485.

[2] Jones, Charles O. Clean Air: Policies and Politics of Pollution Control. Pittsburgh, Pa.: University of Pittsburgh Press, 1975, p. 84.

[3] Clean Air Act Amendments of 1970, Pub. L. 91-104, 84 Stat. 1676.

[4] Jones, Charles O. "Speculative Augmentation in Federal Air Pollution Policy Making." Journal of Politics, Vol. 36 (May 1974), p. 447.

The 1970 Amendments also provided for extended state involvement in and supervision of local programs by granting the states comprehensive responsibility for developing adequate SIP's. A cooperative program was thus established on two levels: one between the federal and state governments and a second among the various states and local governments. The 1970 Amendments require an active state and local role in defining state regions, coordinating among regions, developing statewide standards, defining interstate problems, and developing the statewide implementation plan.[1] In this respect federal air pollution law as evidenced in the 1970 bill defined a major coordinating role for the states. There was no provision for a similar role for local governments.[2]

New CAA Amendments were passed by Congress in 1977.[3] While the 1977 Amendments represent a continuation of the basic air pollution control philosophy established by the 1970 Amendments,[4] they contain a number of important new provisions which affect western energy development. These provisions will be discussed in the next section which describes the current status of the air quality regulatory system and the problems and issues that exist relative to western energy development.

B. Current Air Quality Regulations and Conflicts

The previous section briefly reviewed how the air quality regulatory system has evolved incrementally, primarily during the past fifteen years. A brief description of the current status of air quality regulations follow together with an identification of some of the major problems and issues that exist, especially as they pertain to western energy development. While we have attempted to put some logic and order into the descriptions, in fact the regulatory system is a maze. If the reader comes away with the feeling that he understands the air pollution regulatory system, we have failed since we will have created the illusion of order where there is chaos.

The existing air quality regulatory system consists of two types of standards: emission standards which limit the amount of pollution that can be emitted by any source (usually expressed in lbs per unit of energy input); and air quality standards which limit the maximum concentration of certain pollutants that can exist at ground level (usually expressed in micrograms per cubic meter). Each kind of standard is identified and briefly described here, the emphasis being on those which are most important for western energy development areas.

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[1] Jones, Charles O. "Federal-State-Local Sharing in Air Pollution Control." Publius, Vol. 4 (Winter 1974), p. 83.

[2] Magida, Arthur J. "New Clean Air Provisions Respond to Local Complaints." National Journal, Vol. 7 (November 22, 1975), p. 1589.

[3] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 685.

[4] Easton, Eric B., and Francis J. O'Donnell. "The Clean Air Act Amendments of 1977--Refining the National Air Pollution Control Strategy." Journal of the Air Pollution Control Association, Vol. 27 (October 1977), pp. 943-47.

Emission Limits

- Federal NSPS: These standards set the maximum allowable emission rates (lbs/10^6 Btu's fuel input) for certain pollutants for each specific type of facility (e.g., coal-fired power plants and coal preparation plants). The 1977 CAA Amendments will require the best system of continuous emission reduction on new facilities regardless of fuel quality (i.e., BACT).[1]
- SIP Limits: These plans require that emission standards be set for various categories of sources. The state standards for new or modified sources must be at least as strict as the federal NSPS.[2] Table 6-7 lists the SO_2 emissions limits for coal-fired boilers for the eight states. As indicated, five of the states have standards for new plants more strict than the existing federal NSPS of 1.2 lbs of SO_2 per million Btu's of input.[3]
- Offsets in Nonattainment Areas: An "offset policy" exists in order not to preclude economic development in areas that do not meet federal ambient air quality standards (i.e., nonattainment areas). Briefly, the requirements of this policy include the use of the "lowest achievable emission rate" (LAER) on new sources and emission reductions from other sources such that the reductions more than offset the emissions of the new source.[4]
- Hazardous Air Pollutants: These regulations establish emission standards for exceptionally toxic pollutants such as asbestos, beryllium, mercury, and vinyl chloride. The 1977 amendments[5]

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[1] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 697-703, § 109.

[2] For a description of these state standards, see White, Irvin L., et al. Energy From the West: Energy Resource Development Systems Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming, Chapter 2.

[3] This assumes that the 65 percent SO_2 control standard in New Mexico is more strict than the NSPS of 1.2 lbs of SO_2 per million Btu's fuel input.

[4] Clean Air Act Amendments of 1977, § 129.

[5] Ibid., § 110.

TABLE 6-7: STATE SULFUR DIOXIDE EMISSION STANDARDS FOR COAL-FIRED BOILER

STATE	APPLICABILITY	EMISSION REGULATION
Arizona	Existing New	1.0 lb. SO_2/MMBtu 0.8 lb. SO_2/MMBtu
Colorado	Existing New	1.2 lb. SO_2/MMBtu 0.4 lb. SO_2/MMBtu (for facilities greater than 250 MMBtu/hr)
Montana	New	1 lb. SO_2/MMBtu plus maximum control capability which is technically practical and economically feasible as determined by Air Quality Bureau
New Mexico	New	65% SO_2 control
North Dakota		None, other than Federal NSPS
South Dakota		None, other than Federal NSPS
Utah		None, other than Federal NSPS
Wyoming		0.2 lb. SO_2/MMBtu

SO_2 = sulfur dioxide
lb = pound
MMBtu = million British thermal units
hr = hour

Source: Crenshaw, John et al. Alternatives for Revising the SO_2 New Source Performance Standard for Coal-Fired Power Steam Generators, Staff Study. Research Triangle Park, N.C.: U.S., Environmental Protection Agency, Office of Air Quality Planning Standards, Strategies and Air Standards Division, Energy Strategies Branch, 1976.

allow EPA to set a design, equipment, work practice, or operational standard for hazardous materials when an emission standard is not feasible.

- Mobile Emission Standards: These standards establish maximum emission rates for motor vehicles (lbs/vehicle-mile) for CO, HC, and NO_x.

Air Quality Limits

- National Ambient Air Quality Standards (NAAQS): Two categories (primary and secondary) of maximum permissible ground-level concentrations of pollutants are established by the NAAQS. At the present time, there are standards for six pollutants: suspended particulates, SO_2, CO, photochemical oxidants, HC (nonmethane), and NO_x. The current NAAQS are listed in Table 6-8. Primary standards are defined as having the goal of protecting public health, while secondary standards are defined as having the goal of protecting public welfare (i.e., property, crops, wildlife, livestock, aesthetics, etc.).

- State Ambient Air Quality Standards: As part of the SIP requirement, each state sets ambient air quality standards that must be at least as strict as NAAQS. Each of the eight states in our study area has complied with this requirement, and some have set standards for pollutants other than the six criteria pollutants. Seven of the states (all except Utah) have set SO_2 air quality standards below the federal primary standards for annual arithmetic mean and maximum 24-hour concentration.

- PSD Standards:[1] Three land classifications for allowable increases in particulates and SO_2 in areas where existing air quality is cleaner than required by NAAQS are established by PSD standards. Class I areas would be allowed the smallest increases. Some areas such as national parks larger than 6,000 acres and national wilderness areas are mandatory Class I areas. Figure 6-2 shows the mandatory Class I areas in the eight-state study area. All other areas are initially designated Class II. These areas can be redesignated to either Class I or the less restrictive Class III by the states or Indian tribes, except that certain areas, such as national monuments, national preserves, and national wilderness areas, can not be redesignated Class III if the area in question is larger than 10,000 acres. Within two years of the passage of the 1977 CAA Amendments, EPA must submit plans for PSD from NO_x, HC, CO, and oxidants. Table 6-9 gives the specific allowable PSD increments for particulates and SO_2 for each of the three calssifications. Except for the Class I 18-day variance case, the increments may

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[1] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 731 § 127.

TABLE 6-8: NATIONAL AMBIENT AIR QUALITY STANDARDS[a]

POLLUTANT	AVERAGING INTERVAL	PRIMARY STANDARD $\mu g/m^3$ (ppm)	SECONDARY STANDARD $\mu g/m^3$ (ppm)
Sulfur Dioxide	Annually	80 (0.03)[b]	-
	24-hr	365 (0.14)[c]	-
	3-hr	-	1,300 (0.5)[c]
Particulate Matter	Annually	75[d]	60[d,e]
	24-hr	260[c]	150[c]
Carbon Monoxide	8-hr	10,000 (9)[c]	10,000 (9)[c]
	1-hr	40,000 (35)[c]	40,000 (35)[c]
Photochemical Oxidants	1-hr	160 (0.08)[c]	160 (0,08)[c]
Hydrocarbons (nonmethane)	3-hr (6-9 a.m.)	160 (0,24)[c,f]	160 (0.24)[c,f]
Nitrogen Dioxide	Annually	100 (0.05)[b]	100 (0.05)[b]

$\mu g/m^3$ = micrograms per cubic meter
ppm = parts per million
hr = hour

[a] 40 C.F.R. 50(1976). Environmental Protection Agency (EPA) has also proposed a primary and secondary national ambient air quality standard for air borne lead of 1.5 $\mu g/m^3$, monthly arithmetic mean. 42 Fed. Reg. 63,076-83 (December 14, 1977). The Clean Air Act Amendments of 1977 (Pub. L. 95-95, 91 Stat. 720, § 122) direct EPA to study radioactive pollutants, cadmium, aresnic, and polycyclic organic matter for possible inclusion as criteria pollutants.

[b] Arithmetic mean.

[c] Maximum concentration not to be exceeded more than once per year.

[d] Geometric mean.

[e] For use as a guide to assess implementation plant to achieve the 24-hr standard.

[f] For use as a guide in devising implementation plant to achieve oxidant standards.

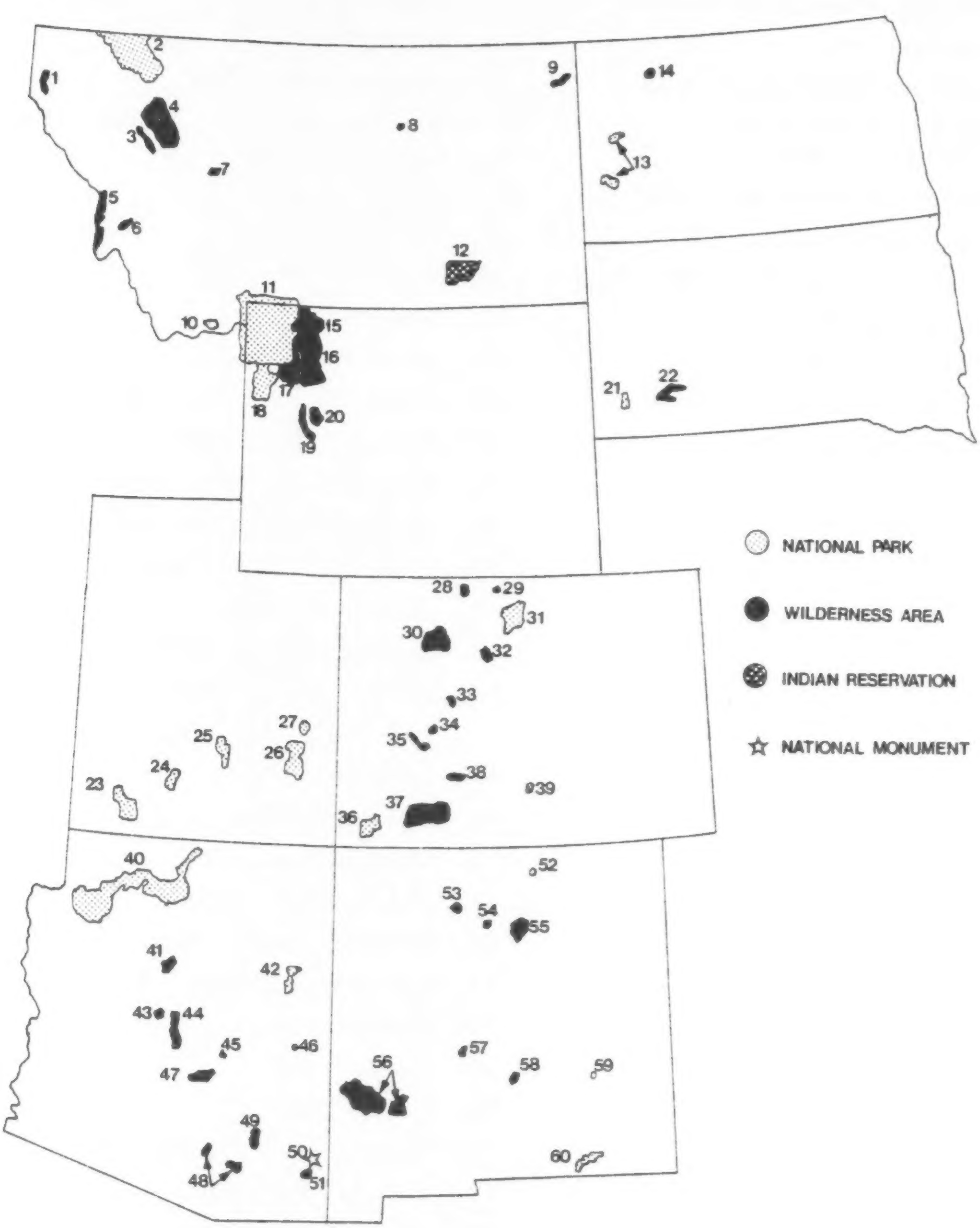
NATIONAL PARK
WILDERNESS AREA
INDIAN RESERVATION
NATIONAL MONUMENT
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FIGURE 6-2: MANDATORY CLASS I AREAS UNDER THE 1977 CLEAN AIR ACT AMMENDMENTS[a]

[a]1. Cabinet Mountains WLD
2. Glacier NP
3. Mission Mountains WLD
4. Bob Marshall and Scapegoat WLD
5. Selway-Bitterroot WLD
6. Anaconda-Pintlar WLD
7. Gates of the Mountain WLD
8. U L Bend WLD
9. Medicine Lake WLD
10. Red Rock Lakes WLD
11. Yellowstone NP
12. Northern Cheyenne Indian Reservation
13. Theodore Roosevelt NP
14. Lostwood WLD
15. N. Absaroka WLD
16. Washakie WLD
17. Teton WLD
18. Grand Teton NP
19. Bridger WLD
20. Fitzpatrick WLD
21. Wind Cave NP
22. Badlands WLD
23. Zion NP
24. Bryce Canyon NP
25. Capitol Reef NP
26. Canyonlands NP
27. Arches NP
28. Mount Zirkel WLD
29. Rawah WLD
30. Flattops WLD
31. Rocky Mountain NP
32. Eagles Nest WLD
33. Maroon Bells/Snowmass WLD
34. West Elk WLD
35. Black Canyon of the Gunnison WLD
36. Mesa Verde NP
37. Weminuche WLD
38. La Garita WLD
39. Great Sand Dunes WLD
40. Grand Canyon NP
41. Sycamore Canyon WLD
42. Petrified Forest NP
43. Pine Mountain WLD
44. Mazatzal WLD
45. Sierra Ancha WLD
46. Mount Baldy WLD
47. Superstition WLD
48. Saguaro WLD
49. Galiuro WLD
50. Chiricahua NM
51. Chiricahua WLD
52. Wheeler Peak WLD
53. San Pedro Parks WLD
54. Bandelier WLD
55. Pecos WLD
56. Gila WLD
57. Bisque del Apache WLD
58. White Mountains WLD
59. Salt Creek WLD
60. Carlsbad Caverns NP

WLD = wilderness area
NP = national park
NM = national monument

TABLE 6-9: PREVENTION OF SIGNIFICANT DETERIORATION ALLOWABLE INCREMENTS[a]
(micrograms per cubic meter)

	TOTAL SUSPENDED PARTICULATES		SULFUR DIOXIDE		
	ANNUAL	24-HOUR	ANNUAL	24-HOUR	3-HOUR
Class I	5	10	2	5	25
Class I "relief"	19	37	20	91	325
Class I 18-day variance:					
low terrain	-	-	-	36	130
high terrain	-	-	-	62	221
Class II	19	37	20	91	512
Class III	37	75	40	182	700

Source: Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 732-38, as cited in Garvey, Doris B., et al. The Prevention of Significant Deterioration: Implications for Energy Research and Development. Argonne, Ill.: Argonne National Laboratory, Office of Environmental Policy Analysis, 1978.

[a] Except for the Class I 18-day variance case, the increments are allowed to be exceeded only one time per year.

only be exceeded one day per year. The Class I "relief" and 18-day variance cases are allowed only after a review and approval process specified in the legislation.

- Visibility Protection for PSD Mandatory Class I Areas: Under 1977 CAA Amendments, EPA has two years within which to develop regulations for remedying or preventing impairment of visibility in mandatory Class I areas as a result of man-made air pollution.

It should be noted that the above categories of standards are not independent; the applicable or limiting standard for any facility will vary from case to case depending on the characteristics of the technology, the type of fuel, the date the plant is constructed or modified, and the facility's specific location. For example, the emissions for a coal-fired power plant may be constrained in one site by SIP emission limits and in another site by PSD regulations. The regulations are made even more difficult to understand and implement because they are continually being revised and being reinterpreted by either EPA or the courts.

As indicated in the introduction to this section, these various air quality regulations are controversial. In large part, this is due to the inadequacy of the scientific knowledge base linking air pollution concentration levels to effects on human health, property, and the environment. For example, the NAAQS for SO_2 and particulates established by EPA were based on the results of statistical studies that compared SO_2 and particulate concentration levels to community health data (e.g., the so-called CHESS study).[1] However, a number of subsequent analyses have questioned the scientific validity of these findings.[2] Recent evaluations indicate that although SO_2 and particulates are related to health problems, their presence may simply indicate the existence of the true culprit--sulfates. As a result of these findings, EPA is in the process of evaluating a regulatory program for sulfates. However, at the present time there are insufficient data and knowledge concerning the atmospheric formation of sulfates to establish such a program. Other areas where there is still great uncertainty include the impacts of air pollution on weather patterns and the possible long-term climatic changes caused by the build-up of carbon dioxide in the atmosphere (the so-called "greenhouse effect").

The important point is that in the near future we are not likely to have complete scientific information about the precise impacts of air pollution. Thus, regulations will continue to be set in a condition of uncertainty. This creates a fundamental problem: how to reach political consensus regarding the appropriate national strategy for balancing energy and economic with health and environmental goals.

In summary, the air quality regulatory system is very complex and controversial. Especially since the 1973 Organization of Petroleum Exporting Countries (OPEC) embargo, there has been intense public debate over the conflicts between increased domestic energy production and the goal of maintaining and enhancing air quality (and other environmental values). While many of the issues are national in scope, some are especially important to the West. In the following pages, four major areas of conflict involving western energy development and air quality will be described. These four problem/issue areas are: PSD and visibility standards; emissions offset policies; BACT requirements; and the role of various levels of government in air quality regulation.

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[1] Community Health and Environmental Surveillance System (CHESS) Study, sponsored by the EPA.

[2] For a review of some of these criticisms see, for example, "Air Quality and Health." Electric Power Research Institute Journal, Vol. 2 (September 1977), pp. 6-11; and U.S., Council on Environmental Quality. Environmental Quality, Seventh Annual Report. Washington, D.C.: Government Printing Office, 1976, pp. 213-47.

(1) PSD and Visibility Standards

The concept of PSD was first included in the Air Quality Act of 1967,[1] supported by the 1969 Guidelines for the Development of Air Quality Standards and Implementation Plans issued by HEW's National Air Pollution Control Administration,[2] and continued by Congress in the CAA Amendments of 1970.[3] However, the Administrator of EPA did not include PSD in his 1971 implementation plan guidelines. His failure to do so was successfully challenged by the Sierra Club on the basis that the 1967 Act, the 1970 Amendments, and the legislative history of air quality control required a policy of PSD of air of better quality than that required by NAAQS.[4] PSD regulations were established by EPA in December 1974 and were immediately challenged by both industry and environmental groups.[5]

Congress actively considered PSD amendments to the CAA beginning in 1975, but it was not until 1977 that PSD requirements were actually legislated.[1] EPA issued proposed PSD regulations in late 1977,[2] but, as of June 1978, the final regulations have not been promulgated. The Congress stated that the purpose of this legislative requirements was to protect public health and welfare; to preserve, protect, and enhance air quality in unique national lands; to ensure that emissions in one state will not interfere with another state's SIP; and to ensure that decisions to permit increased air pollution are made only after careful evaluation and informed public participation.[3]

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[1] Air Quality Act of 1967, Pub. L. 90-148, 81 Stat. 485, stated that a purpose of the act was to "protect and enhance the quality of the nation's air resources."

[2] Those guidelines state that "Air quality standards which, even if fully implemented, would result in significant deterioriation in air quality...clearly would conflict with the expressed purpose of the law." See U.S., Department of Health, Education, and Welfare, Public Health Service, National Air Pollution Control Administration, Consumer Protection and Environmental Health Service. Guidelines for Development of Air Quality Standards and Implementation Plans. Washington, D.C.: Public Health Service, 1969.

[3] The first stated purpose of the Clean Air Act of 1970, Pub. L. 91-604, 84 Stat. 1976, was "to protect and enhance the quality of the nation's air resources so as to promote the public health and welfare and the productive capacity of its 'population'."

[4] Sierra Club v. Ruckelshaus, 334 F. Supp. 253 (D.D.C. 1972), affirmed, 4 ERC 1815 (D.C. Cir. 1972), affirmed sub nom., Fri v. Sierra Club, 412 U.S. 541 (1973). The ruling of the district court was upheld by the Circuit Court of Appeals and affirmed by a divided (4-4) Supreme Court.

[5] See "Clean Air Act Amendments of 1977: Legislative History." U.S. Code Congressional and Administrative News, Vol. 2: Legislative History. St. Paul, Minn.: West, 1978, p. 1183. And Ayers, Richard E. "Enforcement of Air Pollution Controls on Stationary Sources Under the Clean Air Amendments of 1970." Ecology Law Quarterly, Vol. 4 (No. 3, 1975), pp. 460-63.

However, the PSD regulations may also have a number of other influences as well. The National League of Cities and the National Association of Counties argued that without PSD, regions with dirtier air would be at a competitive disadvantage in attracting industry. Further, states wanting to maintain areas of pristine air quality would have greater difficulty doing so without a PSD policy.[4] This is especially important for states whose economy depends on tourism related to scenic beauty--for example, Colorado and New Mexico, both of which have actively supported PSD.[5]

The House Health and Environment Subcommittee found that the transport of pollutants from one state to another and pressure for industrial growth would make it difficult for states to decide to maintain air quality better than that required by minimum federal standards and that a state's freedom to set standards more restrictive than the federal standards would effectively be limited.[6] They also found that, without PSD regulations, air quality in unique national lands (such as the Grand Canyon) could decline significantly. For example, the normal 70-100 miles visibility in the Grand Canyon could be reduced to 15 or so miles as a consequence of ambient concentrations of SO_2 at the level of the secondary ambient air quality standard. Under worst-case weather conditions (which occur about once a year), visibility could be reduced to as little as 3 or 4 miles.[7]

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[1] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 731 § 127.

[2] 42 Fed. Reg. 57,471-88 (November 3, 1977); and 42 Fed. Reg. 62,020-21 (December 8, 1977).

[3] Clean Air Act Amendments of 1977.

[4] "Clean Air Act Amendments of 1977: Legislative History." U.S. Code Congressional and Administrative News, Vol. 2: Legislative History. St. Paul, Minn.: West, 1978, pp. 1211-13.

[5] *Ibid.*, pp. 1214-15.

[6] *Ibid.*, p. 1215.

[7] *Ibid.*, p. 1216.

The PSD requirements of the 1977 Amendments create a number of problems and questions that could significantly affect western energy development. Under PSD regulations, a facility is given a permit to begin construction if predictions from an atmospheric diffusion model[1] indicate that the facility will not violate the PSD standard. This raises concerns because current air quality models can generally only estimate impacts to within a factor of two of the actual impacts which will occur, although in areas of complex terrain or unusual meteorology these models are even less accurate.[2]

Because of this modeling limitation, the 1977 Amendments require EPA to hold a conference on air dispersion modeling within six months of passage of the amendments and at least every three years thereafter.[3] In addition, as noted previously, the amendments call for EPA to study the other criteria pollutants not now covered by PSD and to set PSD regulations for these pollutants within two years. However, the interrelationships among the six criteria pollutants and deterioration of air quality (for example, the formation of oxidants) are not well understood and cannot be determined accurately. EPA has contended that it does not have the technology or modeling capability to regulate these pollutants on a case-by-case basis.[4] In summary, the net effect of these modeling inadequacies is to increase uncertainty about future regulations and to delay and perhaps constrain some energy development.

Another potential problem area has to do with the process of reclassifying PSD areas as specified in the 1977 Amendments. The process, which can be initiated by governors or Indian tribal councils, requires a public hearing in the locale affected, approval by the state, and when federal lands are affected, consultation with the appropriate federal land manager.[1]

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[1] These models are usually computer simulations which predict changes in ambient air quality from a facility based on the volume, rate of discharge, and temperature of emissions from the facility, the stack height, and the meteorology and terrain of the nearby area.

[2] White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. IV, Appendix A, pp. 12-13.

[3] The first such conference was held in March 1978.

[4] "Clean Air Act Amendments of 1977: Legislative History." U.S. Code Congressional and Administrative News, Vol. 2: Legislative History. St. Paul, Minn.: West, 1978, pp. 1485-86.

The attempt of Dunn County, North Dakota, to be redesignated Class I, illustrates some of the problems in this process. A petition requesting the required local government approval was circulated, the petition was signed by a large number of people, and the county government passed an appropriate resolution. But the process then stalled for the required environmental assessment. Requests to the state and to EPA for funds were unsuccessful, so no further action has been taken.[2]

Another example of the reclassification process in action is the redesignation of the Northern Cheyenne Indian Reservation in Eastern Montana to Class I[3] (see box). According to the Northern Cheyenne, the request was made to protect their values and lifestyle and to prevent further degradation in air quality.[4] On the other hand, the tribal chairman of the adjacent Crow Reservation, Patrick Stands Over Bull, has written to EPA that the Northern Cheyenne's request for redesignation as Class I status "...has serious ramifications on coal development on the Crow Reservation."[5] The State of Wyoming also filed an objection to the redesignation request by the Cheyenne Indians on the grounds

RECLASSIFICATION CONFLICT

The Northern Cheyenne tribal chairman, Allan Rowland, has stated that "we are not requesting this redesignation because we are against progress. For us progress means developing our environmental resources in renewable and compatible manners such as timber and agricultural products. They are the cores of our value systems as people."

When the State of Wyoming objected to the redesignation citing possible restrictions on development in some parts of the state, Eric Metcalf, a Cheyenne spokesman, replied, "They're saying: 'We want to make decisions in our area, but you can't make those decisions for yours.'"

--"The Cheyennes Drive for Clean Air Rights." Business Week, April 4, 1977, p. 29.

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[1] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 733-35.

[2] Metzger, Dr. Charles, Energy Coordinator, North Dakota Governor's Office. Personal communication, December 9, 1977.

[3] Old West Regional Commission Bulletin, Vol. 4 (September 1, 1977), p. 4.

[4] "Currents." Environmental Science and Technology, Vol. 2 (October 1977), p. 946.

[5] "The Cheyennes Drive for Clean Air Rights." Business Week. April 4, 1977, p. 29.

that it could limit energy development in northern Wyoming.[1] Another objection over redesignation came from Montana Power Company concerning construction of Colstrip 3 and 4 near the reservation. EPA attempted to require a PSD permit for the facilities, but Montana Power Company successfully sued EPA on the grounds that these units were already under construction when the classification rules were passed and, therefore, exempt. The case is currently under appeal. Montana Power attempted to begin site preparation in late 1977 but were blocked by EPA since they did not have a permit, even though the court had ruled they did not need one. In order to possibly save time while the case was under appeal, Montana Power Company filed for a PSD permit even though they believed that one was not required. On June 12, 1978, EPA issued a final decision not to grant a construction permit for Colstrip 3 and 4 because the plant would violate the Class I PSD Standard. Before taking any further action, the five companies involved in the project are awaiting a decision of the appeals court on the earlier court ruling that since the construction application was filed on June 6, 1973, the units are not subject to PSD regulations.[2]

Another important issue concerning PSD regulation and western energy development has to do with how the "baseline" air quality level should be determined and what emissions should be included in the allowable increment. The 1977 Amendments state that at the time of the first PSD permit application in any area, the ambient pollution level will be measured and designated the "baseline concentration" by EPA.[3] To be included in this baseline is the projected emissions from facilities on which construction commenced before January 6, 1975, but which are not yet in operation. In the proposed PSD regulations, EPA also plans to include well-defined secondary emissions associated with the major emitting facility in the increment.[4] This could be especially important for plants which will result in relatively large population growth in the rural West. These urban emissions could reduce the available increment for the energy facility, a consequence over which industry would have no direct control. In fact, local and state officials have only limited control since the control of auto emissions is almost entirely preempted by the federal government. (This point is discussed in more detail later in this section.)

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[1] "The Cheyennes Drive for Clean Air Rights." Business Week, April 4, 1977, p. 29.

[2] Schmechel, Warren, Western Energy Company. Personal communication, June 1978.

[3] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 731, § 127.

[4] 42 Fed. Reg. 57,480 (November 3, 1977).

Another potential problem occurs because if wind blown dust from surface mining operations is included in the increment, it is likely to cause the particulate PSD Standard to be exceeded in a great many cases. Currently, EPA is planning to exclude these fugitive dust emissions in the PSD increment but this policy could possibly be challenged in the courts by environmental interest groups.

Another major point of conflict occurs because there are numerous mandatory Class I areas in the eight-state study area, especially in southern Utah and western Colorado (see Figure 6-2 given previously). This could limit economic development in the region. The situation with the Intermountain Power Plant in Utah is an example of this concern. This facility will utilize water from the Fremont River which is too low in quality to be suitable for any other beneficial use. However, the site is only eight miles from a mandatory Class I area, Capitol Reef National Park, and would probably violate Class I standards in the park. State Senator Ernest H. Dean has pointed out that this is very frustrating for the people of Utah, largely because the public facilities are of poor quality and the park is seldom used. On this basis, Senator Dean says that the concern about its air quality does not seem to be justified.[1]

The U.S. Chamber of Commerce has attacked PSD as a "...no growth federal land use control based on one criterion--degradation of air." The Chamber argues that 70 to 80 percent of the land area in some states would be off limits to any new development since areas from 50 to 60 miles around Class I areas would be excluded.[2]

EPA believes that the availability of effective emissions controls and alternative sites will mean that PSD regulations will not seriously restrict energy development. There have been several analyses based on air diffusion models that have estimated the required separation distance between major emitting facilities and Class I areas.[3] For example, Table 6-10 lists the separation distance that would be required for power plants under the

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[1] Dean, Ernest H., Utah, State Senator. Comments at National Conference of State Legislators, Energy Policy Planning Workshop, Denver, Colorado, December 9, 1977.

[2] "Clean Air Act Amendments of 1977: Legislative History." U.S. Code Congressional and Administrative News, Vol. 2, Legislative History. St. Paul, Minn.: West, 1978, pp. 1236-37.

[3] For a review of some of these studies, see Garvey, Doris B., et al. The Prevention of Significant Deterioration: Implications for Energy Research and Development. Argonne, Ill.: Argonne National Laboratory, Office of Environmental Policy Analysis, 1978.

TABLE 6-10: SEPARATION DISTANCES FROM CLASS I AREAS REQUIRED TO MEET PREVENTION OF SIGNIFICANT DETERIORATION REGULATIONS FOR SULFUR DIOXIDE: 80 PERCENT SULFUR DIOXIDE CONTROL

POWER PLANT	SIZE (MWe)	REQUIRED SEPARATION DISTANCE
Escalante	3,000	>25.0[a]
Kaiparowits (Nipple Bench)	3,000	>25.0[a]
Rifle	1,000	13.6
Farmington	3,000	58.0
Beulah	3,000	75.0
Gillette	3,000	44.0
Colstrip	3,000	75.0

MWe = megawatt-electric

> = greater than

[a] Class I buffer zone size cannot be established due to the complex terrain in the Kaiparowits/Escalante area.

meteorological and terrain conditions at each of the six scenario sites used in this study.[1] It should be noted that, except for the 1,000 MWe plant at Rifle, these figures are based on 3,000 MWe power plants, 80 percent SO_2 removal, a requirement that increments be exceeded no more than one day per year, and the assumption that only the emissions from this single plant would be counted in the increment. Of course, all of these factors can vary from case to case, making it very difficult to make generalizations about required separation distances. Also, the calculations underlying Table 6-10 do not include possible visibility effects and possible future regulations covering other pollutants. Given these factors, the fact that additional areas can be redesignated Class I, and the current inadequacy of air diffusion models used to predict PSD violation, it becomes clear that it is not possible at this time to make a reliable assessment of the extent to which PSD regulations could constrain energy development in the West.

(2) Emissions Offset Policies

An emission offset policy to permit new polluting industry in areas where national air quality standards have not been met (nonattainment areas) was formulated by EPA in 1976 and was included in the CAA Amendments of 1977.[2] This policy was intended to permit the growth of clean industry in polluted areas. The alternative seemed to be to prohibit industrial development in the nonattainment areas until air quality standards were met.[1] As described previously, under the offset policy, new air emission sources are permitted if existing sources reduce their emissions enough to more than compensate for emissions from the new facility. The new facility (or major addition to an existing facility) must also meet a LAER requirement.[2]

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[1] See White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming, Chapters 4 through 9.

[2] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 685.

Many state and local governments and industry officials (mainly oil, chemical, and steel companies) opposed the offset plan on the basis that it would be unworkable and would constitute a defacto no growth policy. While environmentalists were not enthusiastic about the plan, they generally preferred it to a less stringent alternative considered by EPA under the 1970 act.[3]

In the eight-state study area (and in other areas as well), the emissions offset policy generates controversy because it is perceived as having inequitable effects on different regions of the country.[4] There are several reasons for this feeling. One reason that is important for the West is due to the high levels of some pollutants, especially particulates and HC, that occur naturally in some areas. If these "naturally occuring" levels are included in ambient air quality measurements and NAAQS are exceeded, there would be no sources to use as an "offset" for new emission sources. Thus, economic development in these areas would effectively be blocked, while development could be allowed in industrialized, nonattainment areas. The key issue revolves around uncertainty as to how emissions from naturally occurring sources will be counted when measuring ambient air quality standards[5] (see box "Colorado Particulate Study").

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[1] Congressional Quarterly, Inc. Congress and the Nation, Vol. IV: 1973-1976. Washington, D.C.: Congressional Quarterly, 1977, p. 304.

[2] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 745, § 129.

[3] Congressional Quarterly. Congress and the Nation: 1973-1976. p. 304.

[4] See McKee, Herbert C. "The Problem of Equity in Emissions Offset." Journal of Air Pollution Control Association, Vol. 28, (June 1978), pp. 602-3.

[5] See the comments of Joseph Palomba, Jr., Colorado Air Pollution Control Commission in, "Report on Sixth APCA Government Affairs Seminar." Journal of the Air Pollution Control Association, Vol. 28 (June 1978), p. 575.

Another reason for the controversy is that the emissions offset policy is viewed by some westerners as favoring economic growth in already highly polluted areas over "cleaner" areas in the West. In areas with large numbers of "dirty" sources, a considerable amount of economic growth could be allowed by reducing emissions from existing sources. In clean areas of the West, some believe that economic growth will be more highly constrained by Class I or Class II PSD increments.

(3) BACT Requirements

The NSPS for SO_2 of 1.2 lb. per 10^6 Btu promulgated by EPA for large, coal-burning facilities was the major contributor to the boom in demand for western coal. The reason was that much western coal has a sulfur content so low that it can be used without or with only limited sulfur controls and still meet the NSPS (see Table 6-3 given previously). Therefore, many utilities in the Midwest and Southwest made long-term contracts for western coal (primarily Northern Great Plains coal). They calculated that it was cheaper to buy this inexpensively mined coal and ship it very long distances than to buy higher sulfur local coal and install FGD units.

COLORADO PARTICULATE STUDY

The Colorado Senate Committee on Health, Environment, Welfare and Institutions passed a resolution (subject to Senate approval) asking the Colorado Air Pollution Commission to study the health effects of air borne particles and suggest air quality standards. The goal is to find a way in which large dust particles that naturally occur could be discounted when air quality is measured and perhaps allow more industrial development in the southern part of the state.

State Senator Harvey Phelps argued that if naturally occurring dust particles, common to an arid climate, are included in the measurement of air quality, some areas of the state will always exceed air pollution standards. "Then we always come out high and aren't allowed to grow, while growth goes on in dangerously polluted areas."

--"Study May Suggest New Air Standards." Denver Post, January 19, 1978, p. 45.

In the 1977 Amendments, Congress decided that this unintended side effect of the NSPS was undesirable and has developed two policies (one direct and one indirect) that are intended to produce a more balanced demand for western, interior, and eastern coals. These policies are the NSPS requirement for some degree of active emission control regardless of the original sulfur content of the coal (i.e., BACT) and a provision that allows the governor of a state to require a utility to use locally mined coals rather than importing coal from another state or region.[1] The major points of the 1977 Amendments concerning NSPS are summarized below.[1]

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[1] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 722 § 122.

EPA is to review and revise NSPS every four years (the first to be completed August 7, 1978). The law requires substantial improvement in the standards of performance for major sources through mandatory use of the "best technological system of continuous emission reduction" (i.e., BACT), which--taking into consideration costs, nonair quality health and environmental impacts, and energy requirements--is defined as a process which is inherently low-polluting or nonpolluting, or a system for continuous reduction of pollution before pollutants are emitted, including precombustion treatment. EPA may not require any particular technological system of control such as FGD. However, the use of untreated, low-sulfur fuel and certain other strategies, such as intermittent control systems, are precluded as means of compliance. The standards are required to include both an emission limitation and a percentage reduction of SO_2, particulates, and NO_x. Congress left the explicit quantitative expression of these standards to EPA.

Although several potential emission control processes under development may be used to burn coal cleanly, FGD is the most fully developed technology, and these scrubbers are now capable of removing up to 95 percent of the sulfur emissions. However, these scrubbers produce an inert sludge that must be disposed of, usually in on-site evaporative holding ponds.

The electric utility industry has argued that SO_2 scrubbers aren't reliable,[2] are too expensive, and produce a significant solid waste disposal problem. One projection indicates that FGD units on coal-fired boilers could produce 55 million metric tons (dry basis) of sludge annually by the year 1995.[3] EPA, on the other hand, argues that FGD units have been proven reliable, that their costs are justified in order to protect human health and the environment, and that strict standards will encourage the development of improved sulfur control technologies (e.g., fluidized bed boilers or regenerable FGD processes that will virtually eliminate the solid waste disposal problem).

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[1] Krohm, G.C., C.D. Dux, and J.C. Van Kuiken. Effects on Regional Coal Markets of the "Best Available Control Technology" Policy for Sulfur Emissions, National Coal Utilization Assessment. Argonne, Ill.: Argonne National Laboratory, 1977.

[2] For example, the American Electric Power Company waged an intensive advertising campaign in the fall of 1974 arguing that scrubbers don't work. See, for example, New York Times, May 30, 1974.

[3] Teknekron, Inc. Review of New Source Performance Standards for Coal-Fired Utility Boilers, Vol. I: Emissions and Non-Air Quality Environmental Impacts. Berkeley, Calif.: Teknekron, 1978.

EPA has not yet established the precise definition of the BACT standard for SO_2. EPA is expected to propose such standards in July 1978, and, after review and comment, promulgate the final standard (i.e., final for at least the next 4 years).

Several possible definitions of the BACT requirement for SO_2 have been discussed and evaluated by EPA, including:[1] (1) an across-the-board 90 percent reduction regardless of the original sulfur content of the fuel, but with a maximum of 1.2 lbs. of $SO_2/10^6$ Btu's; (2) a tightening of the current NSPS to 0.6 lbs/10^6 Btu's; and (3) a maximum limit of 1.20 lbs/ 10^6 Btu's, combined with either a 90 percent sulfur reduction or a floor of 0.2 lbs/10^6 Btu's, whichever can be achieved first.

Several studies have evaluated alternative NSPS definitions and have concluded that the percentage reduction requirement of the 1977 amendments will achieve the objective of reducing the demand in other regions for low sulfur western coal. For example, one study[2] estimates that in 1990 the production of coal in the Northern Great Plains under an across-the-board 90 percent sulfur reduction requirement will only be 52 percent of the level that would occur under a continuation of the current NSPS--a drop from 388 million tons per year (MMtpy) to 202 MMtpy. This compares to a 1973 production level of 46 MMtpy. Most of the drop occurs in shipments from the Northern Great Plains to the east central region of the county.

Of course supply/demand projections based on econometric models are laced with uncertainties (e.g., future mining costs in different regions and future coal transportation costs), and at least one factor that may tend to reduce the magnitude of this shift in coal supply markets is impossible to quantify. This is the apparent higher supply reliability associated with mainly nonunionized surface mines in the West compared to the mainly unionized, underground mines in the central and eastern coal producing regions. This is of special concern now due to the protracted 1977-78 coal miners strike.

(4) The Role of Various Levels of Government in Air Quality Regulation

This fourth conflict area is different in nature from the previous three in that it deals not with any particular regulation but rather the more pervasive problem of the appropriate role of various levels of federal versus state/local control in the West because of the unique political status of Indian tribes.

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[1] The following descriptions are simplified since the actual standards will allow for short periods when these standards can be exceeded.

[2] Krohm, G.C., C.D. Dux, and J.C. Van Kuiken. Effects on Regional Coal Markets of the "Best Available Control Technology" Policy for Sulfur Emissions, National Coal Utilization Assessment. Argonne, Ill.: Argonne National Laboratory, 1977.

The key issue centers on whether federally established regulations allow for enough flexibility to account for regional differences in the natural environment and the goals of citizens in that area. As noted previously, the states are given primary responsibility in monitoring and enforcing air quality regulations, but generally within fairly narrowly defined bounds set by the federal government. The states may set their own emission and air quality standards but only if they are at least as strict as federal standards. Given the relatively strict federal standards, such as PSD and BACT regulations, this results in very little real state control. It should be noted that representatives of states are not always on the same side of the argument; for example, Senator Jake Garn (R-Utah) feels federal regulations have unduly restricted growth in energy production in his state, while Senator Gary Hart (D-Colorado) believes there needs to be greater federal leadership in pollution control (see box).

As noted earlier, the 1977 Amendments give Indian tribes the right to redesignate their reservations as Class I PSD areas. Thus far only one tribe, the Northern Cheyenne, has opted for this classification, and we have discussed the conflicts this action has created. On the other hand, to date there is no case on record where an Indian tribe has formally participated in the formulation or revision of a SIP. Given the legal status of the state-Indian

AIR OF A DIFFERENT QUALITY

Senator Jake Garn feels that Utah is ideal for the development of huge "mine-mouth" generating plants at underground mines for the export of electricity to the growing southwest. He feels that using Utah's low sulfur coal and modern control equipment would essentially make such plants nonpollutors and that these developments (namely the $3.5 billion generating complex at Kaiparowits) would have created a new city of 15,000 residents and a 10 percent increase in Utah's tax base. The Senator states, "...we should...leave it up to the states to meet federal ambient air standards as they see fit. If we don't meet them then the feds can step in and enforce them."

Senator Gary Hart is particularly concerned about the health hazards of increased levels of nitrogen oxides (18 percent by 1985) that would result even with maximum use of scrubbers to reduce sulfur oxide emissions. He does not want Colorado to supply energy for people outside the state while people in his state will be exposed to the public health consequences. Senator Hart feels "...the leadership should come from the White House. They've got to evaluate pollution control to the same level of seriousness as the supply side issues...California can figure out how to generate its own electricity."

--Kirschten, J. Dicken. "Converting to Coal--Can it be Done Cleanly?" National Journal, Vol. 9 (May 21, 1977), pp. 783-84.

relationship it is doubtful that existing SIP's can be applied to new or existing air pollution sources on trust lands.

The issue is also of substantive importance as regards auto emission regulations. The federal government has maintained control over emission standards for mobile sources.[1] While the 1977 Amendments gave states increased authority to inspect mobile sources as part of their SIP's,[2] automobile emissions standards were postponed. This has made it more difficult for states to attain ambient standards. Because the ground level concentration of air pollutants from urban sources may be greater than those from energy facilities in the West, the standards established for mobile sources are crucial in determining the overall impact of western energy development. Also, since each state must determine what measures to include in its implementation plan to meet national ambient standards, it is important that the state know when and by how much ambient pollution concentrations will be reduced by new automobile standards.[3]

State governments continue to try to increase their control over mobile sources of pollution. This is evidenced in the West by Colorado Governor Lamm's listing of state control of auto pollution as the top priority of the 1978 legislative session.[4]

6.2.4 Summary of Air Quality Problems and Issues

Impacts on air quality due to energy conversion facilities depend on several critical technological and locational factors: type of energy facility and the levels of pollution control, labor requirements, resource characteristics, background levels of pollutants, terrain, proximity to pristine air quality areas, and meterological conditions. In general, coal-fired power plants emit more pollutants than any other energy conversion technology and thus give rise to more air quality problems and issues. Within the eight-state study area, facilities located in the Rocky Mountains area are expected to have the most site-specific problems, especially when they are sited in complex terrain and close to Class I PSD areas.

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[1] For a review of recent issues facing the automakers and Congress and a brief history of auto emission controls, see Kirschten, J. Dicken. "It's Washington Taking on Detroit in the Auto Pollution Game." National Journal, Vol. 9 (January 1, 1977), pp. 9-15.

[2] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 689, § 105; and 91 Stat. 751-69, §§ 201-16.

[3] See Connor, J.T. "The Automobile Controversy--Federal Control of Vehicular Emissions." Ecology Law Quarterly, Vol. 4 (No. 3, 1975), pp. 661-92.

[4] Engdahl, T. "Politicos Jockey for Position." Denver Post, January 27, 1978, p. 16.

Air quality regulation has undergone several changes since it became a matter of public concern. Prior to 1955, government regulation of air quality was limited, being the responsibility primarily of a relatively few state and local governments. Because of public concern over increased levels of air pollution and a widespread perception among policymakers that state and local government action had been insufficient, federal authority for air quality was increased throughout the decade of the 1960's over both stationary and mobile sources. Congress mandated a major federal role in air quality control in the CAA Amendments of 1970. The Amendments required EPA to establish NAAQS but gave the states the major role in implementing and enforcing plans to meet these national standards. The 1977 Amendments to the CAA direct states to implement PSD regulations and emissions offset policies according to federal guidelines; however, they leave primary control over NSPS (including BACT), hazardous pollutants, and mobile sources with the federal government.

Air quality problems and issues are potentially one of the most limiting factors on western energy resource development. The national goal to protect and enhance air quality conflicts in a variety of ways with the goal of increased domestic energy production and continued economic growth. Such conflicts have become especially prevalent in the western U.S., where vast, readily accessible energy resources can support large-scale energy development. However, the development of these resources can also pose a threat to the region's scenic beauty, particularly its pristine air quality. Specific problems and issues which appear more critical in the western states are:

- BACT requirements could sharply reduce the short- and midterm demand for western coal, especially in the central region of the country. With a 90 percent sulfur removal standard, by 1990 Northern Great Plains coal production could drop to about half of what it would otherwise be with existing NSPS. However, even with the BACT requirement, western coal production will grow and in 1990 can be expected to be at least five times greater than it was in 1975.

- The large number of Class I PSD areas in some parts of the eight-state study area and the complexity of the PSD regulations could block or slow western energy development activities.

- Some westerners resent the fact that the emissions offset policy allows development in areas already violating NAAQS while its PSD policies could constrain development in areas where air quality is better than is required by NAAQS.

- Intergovernmental conflicts over air quality control already have affected relations among the West and other coal producing regions, and among western states, the federal government, and Indian tribes.

The following section identifies and evaluates policy alternatives for dealing with some of these problems and issues.

6.3 ALTERNATIVE POLICIES FOR AIR QUALITY

6.3.1 Introduction

The discussion in the previous two sections makes it clear that western energy development will both affect air quality and be affected by air quality regulations. And, as the preceding discussion indicates, both give rise to problems and issues which policymakers must attempt to resolve. In dealing with these problems and issues, policymakers will have to attempt to reconcile both energy and environmental policy objectives; that is, the operative overall policy objective is to protect air quality in the West while proceeding with the development of western energy resources.

A variety of alternative policy responses are available to policymakers for attempting to achieve this objective. Several possible categories and specific alternatives are listed in Table 6-11. These categories suggest that policymakers can take an approach which emphasizes standards and regulations, technology and siting choices, and/or institutions and procedures. These approaches or categories and specific alternatives associated with each will be described briefly in the following section. Since it is not feasible to evaluate and compare all nine of the specific policy alternatives identified and briefly described in Section 6.3.2, four which appear to be especially important are singled out for more detailed treatment in Section 6.3.3 and 6.3.4.

6.3.2 Description of the Alternatives

Three specific alternatives for modifying standards and regulations are:

- Define BACT for SO_2 emissions from coal combustion as 90 percent sulfur removal;

- Make PSD standards more flexible; and/or

- Reserve portions of PSD increments for energy production.

Table 6-12 summarizes the implementation strategies and constraints for each of these three policy options.

TABLE 6-11: POLICY ALTERNATIVES FOR AIR QUALITY PROBLEMS AND ISSUES

OBJECTIVE	CATEGORIES OF ALTERNATIVES	SPECIFIC ALTERNATIVES
Protect western air quality while proceeding with western energy resource development	Modify standards and regulations	Define BACT for SO_2 emissions from coal combustion as 90 percent sulfur removal
		Make PSD standards more flexible
		Reserve a portion of PSD increments for energy production
	Alter technological and siting choices	Construct smaller, dispersed energy conversion facilities
		Concentrate facilities in energy parks
		Increase commercialization programs for new, less polluting energy resources and conversion technologies
	Improve procedural mechanisms for approving new facilities	Establish a task force for identifying future sites for energy facilities
		Increase assistance to state and local government planners
		Establish a regional air quality council

BACT = best available control technology
SO_2 = sulfur dioxide
PSD = prevention of significant deterioration

TABLE 6-12: MODIFY REGULATIONS AND STANDARDS: SPECIFIC ALTERNATIVES, IMPLEMENTATION STRATEGIES, AND CONSTRAINTS

SPECIFIC ALTERNATIVE	IMPLEMENTATION STRATEGIES	CONSTRAINTS
Define BACT for SO_2 emissions from coal combustion as 90% sulfur removal	Promulgate standard under 1977 Clean Air Act Amendments	Opposition because of economic costs and because incentive for seeking low sulfur coals are eliminated
Make PSD standards more flexible	Amend legislation to permit PSD increments to be exceeded more frequently	Amending Clean Air Act might be difficult Likely opposition by environmentalists
Reserve a percentage of PSD increments for energy production	Include such "reserved increments" in SIP's	Would probably require EPA approval and possibly congressional action Administration would be complex Likely opposition from other industries

BACT = best available control technology
SO_2 = sulfur dioxide
PSD = prevention of significant deterioration
SIP = state implementation plan
EPA = Environmental Protection Agency

The first of these specific alternatives would define the BACT standard for SO_2 from large coal burning facilities mandated by the 1977 CAA Amendments as requiring 90 percent reduction with an emission maximum of 1.2 pounds of SO_2 per million Btu's input. This definition meets the legislative requirement and is mentioned frequently as a definition being considered by EPA.

At the present time, coal cleaning could be used to remove some sulfur prior to combustion to help meet the 90 percent sulfur removal requirement; however, with currently available technology, some FGD would still be required. It is possible, however, that either coal cleaning or fluidized bed combustion could be utilized to achieve a 90 percent sulfur emissions reduction in the future.

As indicated in Table 6-12, something similar to this alternative is required under the 1977 Amendments. However, because of economic costs and the lack of an incentive for using low sulfur coals, this alternative might well be opposed by industrial and utility coal users.

The other two specific alternatives described in this category are aimed at resolving some of the problems and issues created by current PSD regulations. The first would allow higher levels of energy development by relaxing PSD standards somewhat. As described in a previous section, the 1977 Amendments specify increments for particulates and SO_2, which, with a single exception, can be exceeded only once each year. These increments are set for annual, 24-hour, and 3-hour averages (see Table 6-9).

The 1977 Amendments also require EPA to set PSD standards for other pollutants within the next few years. Modifying the PSD regulations to allow a greater number of times that the 3-hour and 24-hour increments can be exceeded in a year (say 4-6 times) would lessen the possible constraint of PSD regulations on energy facilities. To implement this policy alternative would require amending the CAA, and it is likely that this alternative would be opposed by environmental groups which pressed for stricter PSD standards to begin with.

The second PSD related alternative would reserve a set percentage of allowable PSD increments for energy conversion facilities. This alternative would ensure that energy development is not blocked but would not relax current PSD standards. Since the need for such "reserved increments" will vary considerably from region to region, percentage levels to be reserved for energy development could be set by states, possibly as part of their SIP. This alternative would probably require EPA approval and possibly congressional action. Such an approach is likely to be opposed by other industries, and would probably be difficult to administer.

The second category of alternatives listed in Table 6-11 includes policies which would alter choices of technologies and/or sites. Three specific alternatives in this category are listed in Table 6-13 along with possible implementating strategies and constraints. The three are to:

- Construct smaller, dispersed energy conversion facilities;
- Concentrate facilities in energy parks; and/or
- Increase commercialization programs for new, less polluting energy resources and conversion technologies.

Under the smaller, dispersed energy facilities option, instead of building one 1,500 MWe power plant, for example, industry would build three separate 500 MWe power plants sited far enough apart to avoid significant air emission interactions.

Current ambient air quality regulations (e.g., NAAQS and PSD) can indirectly constrain siting large plants. By siting smaller facilities over a wide area, ground-level air pollution concentrations would be reduced, thus helping to reduce any constraint on energy development resulting from ambient air quality regulations.

This kind of alternative could be implemented in several ways. The most straightforward way would be for industry to choose this approach in response to existing economic and regulatory conditions. In addition, utility commissions could encourage this option by requiring utilities to examine the approach in their planning. Or, incentives (e.g., emission taxes that increase with total-emission levels from a plant) or sanctions (e.g., prohibitions on plants beyond a certain size) could be established by government to force this alternative.

An opposite approach would be to concentrate energy facilities in "energy parks." This alternative would almost certainly sacrifice air quality locally, but such parks could be located away from major population centers and Class I PSD areas so as to minimize adverse environmental and health effects. Implementing the energy park concept would probably require either federal or state action. Federal legislation might be necessary in order to relax current PSD regulations for these areas, and states would have to include provisions for energy parks in their SIP's. In the absence of federal action, the states could implement this alternative on a limited scale by redesignating some areas to a PSD Class III. It may be difficult to site such energy parks in the West because of the large water requirements.

Another specific alternative for altering technological or siting choices would be to increase commercialization programs for new, less polluting energy resources (e.g., geothermal) or conversion technologies (e.g., coal synthetic fuels). As indicated previously in Tables 6-1 and 6-2, some of the energy resource

TABLE 6-13: IMPLEMENTATION STRATEGIES AND CONSTRAINTS FOR SITING ALTERNATIVES

SPECIFIC ALTERNATIVES	IMPLEMENTATION STRATEGIES	CONSTRAINTS
Construct smaller, dispersed energy conversion facilities	Could be implemented by industry in response to economic conditions and environmental regulations; could be encouraged or forced by government regulations	Industry would likely oppose government attempts to force this option Increased number of plant sitings could slow development
Concentrate facilities in energy parks	Federal legislation could relax PSD standards for energy park areas States could designate energy parks in SIP's	Required governmental action may be difficult to bring about Siting such areas in the West could be difficult (e.g., need large available water resources)
Increase commercialization programs for new, less polluting energy resources and conversion technologies	Cooperative federal/state/industry commercialization programs	Economic costs are high Requires cooperation among industry and various levels of government

PSD = prevention of significant deterioration

SIP = state implementation plan

development systems have fewer air pollution problems than others. Currently, most of these less polluting energy alternatives are new and are either still in the research and development stage or are considered too economically risky by industry for commercialization. The aim of this alternative policy is to commercialize these newer, less polluting technologies earlier than might otherwise occur. This could be implemented by cooperative federal/state/industry commercialization programs for those technologies which appear most attractive for use in the West. The most significant obstacle to such an approach is the large economic cost involved.

The third category of policy alternatives for resolving the conflicts between air quality and energy development focuses on the procedural mechanisms by which approval is given to the construction of new facilities. As noted in the description of problems and issues in Section 6.2, air quality regulations and the permitting process for assuring compliance with these regulations is very complex and can often lead to long delays in siting. Table 6-14 lists three specific policy alternatives and implementation strategies aimed at alleviating some of these difficulties:

- Establish a task force for identifying future sites for energy facilities;
- Increase assistance to state and local government planners and other parties-at-interest; and/or
- Establish a regional air quality council.

Under the first of these alternatives, each state in the eight-state study area would establish a task force which includes among its members representatives from the federal government, the state, industry, and other interested parties (e.g., environmental groups, farmers and ranchers, etc.). This task force would be charged with identifying areas which could be used in the future as sites for energy and other industrial facilities. The objective would be that all interests are represented and have a chance to participate in identifying the best or most acceptable areas for siting these facilities. These sites would then be available when needed, hopefully eliminating or lessening siting delays. (For a more general discussion of these types of siting strategies, see Chapter 12 on siting in this report.)

Because of the complexity of the air quality regulatory system, many affected parties often lack adequate technical and financial resources to participate in air quality policymaking on an equal footing with energy industries and the federal government. For example, as indicated earlier, Dunn County, North Dakota, has been unable to fund the environmental assessment required for the county to be reclassified as Class I. Although the 1977

TABLE 6-14: IMPROVE PROCEDURAL MECHANISM FOR APPROVING NEW FACILITIES: SPECIFIC ALTERNATIVES, IMPLEMENTATION STRATEGIES, AND CONSTRAINTS

SPECIFIC ALTERNATIVES	IMPLEMENTATION STRATEGIES	CONSTRAINTS
Establish a task force for identifying future sites for energy facilities	Each state's governor establish a task force to include representatives of interested parties	A consensus might be difficult to reach because of basic disagreements
Increase assistance to state and local government planners and other parties-at-interest	EPA provide technical experts to serve as consultants Provide financial assistance to groups for technical support	Would require increased government expenditures Opposition to government support of special interest groups
Establish a regional air quality council for multistate planning and assessment	Federal and state funding to support such a council, modeled after Western State's Water Council	Would require government funding Would require cooperation among state governments

EPA = Environmental Protection Agency

amendments provide some assistance to states, these funds are primarily intended to support the preparation of SIP's. This alternative would increase financial and technical support for interested groups, primarily using federal government resources. For example, technical experts could be provided by EPA regional offices to serve as consultants to state and local governments and to public interest groups. Or financial support could be provided to these groups so that they could hire their own expert consultants. This kind of activity has already begun to some limited extent. For example, EPA jointly planned and sponsored a series of meetings in the West with the Friends of the Earth. These meetings were intended to provide technical assistance, disseminate information on the 1977 Amendments, and give EPA back on the proposed regulations. The major constraints to such an approach are the increased governmental expenditures required and the opposition by some to the concept of government support of special interest groups. This alternative is similar to the participation process support alternative discussed and evaluated in Chapter 12.

A third alternative in this category would be to establish a regional air quality council to support interstate planning agreements. Federal and state funding could be provided for a "Western Interstate Air Quality Board" for the eight states in our study area. Such a board could be patterned on major existing western multistate organizations such as the Western States' Water Council or the Western Interstate Energy Board. This council would provide advice on air quality to federal, state, and local governments and would help to coordinate multistate air quality planning and impact assessment. Implementing this policy would be difficult due to increased government expenditures and the problems associated with establishing any type of cooperative program among several states.

6.3.3 Evaluation of Alternatives

A. Introduction

Four of the nine specific policy alternatives discussed above will be evaluated and compared in this section. These are:

- Define BACT for SO_2 emissions from coal combustion as 90 percent sulfur removal;
- Construct smaller, dispersed energy conversion facilities;
- Increase commercialization programs for new energy resources and conversion technologies;
- Establish a task force for identifying future sites for energy facilities.

Each of these alternatives will be assessed in terms of the five basic criteria identified and defined in Chapter 3: effectiveness, efficiency, equity, flexibility, and implementability. Table 6-15 shows how these criteria have been defined as they apply to air quality and identifies the quantitative and qualitative measures used in evaluating and comparing the four specific alternatives listed above.

B. Evaluation of BACT Definition

The purpose of this section is to identify the effects of one particular specification of BACT for large, coal combustion facilities, as required by the 1977 CAA Amendments. This specification is for a standard requiring 90 percent sulfur removal and a maximum emission rate of 1.2 lbs. of SO_2 per million Btu's of fuel input.[1]

The following evaluation will examine the incremental effects of the 90 percent sulfur control requirement relative to what the situation would be without it (i.e., the "baseline"). One of the difficult aspects of this evaluation is determining what the "baseline" should be. There are numerous state and federal emission and air quality standards, and the controlling standard can vary from case to case. For example, Colorado currently has a stringent SO_2 emission limit for new plants of 0.2 lbs/10^6 Btu's, but whether this or the 90 percent reduction requirement would be the limiting standard depends on the sulfur content of the coal. In other cases, the emission limits required to meet Class I PSD increments may be the controlling factor. An attempt is made to clarify what the "baseline" assumptions are, but in several of the studies cited in making this evaluation the baseline conditions are not always completely compatible.

Another general point concerning this specific alternative is that the BACT standard will only be applied to plants whose construction commences after publication of the proposed BACT definition (which will be sometime in the summer of 1978), and, therefore, it will usually only apply to plants coming on-line sometime during or after the 1983-85 time period.

(1) How Will Demand for Western Coal be Affected?

The Regional Studies Program at Argonne National Laboratory has analyzed the impact of this policy alternative on western

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[1] Any number of other alternative definitions of BACT for SO_2 could, of course, be considered but it is not feasible to evaluate all of these in this report.

TABLE 6-15: EVALUATIVE CRITERIA AND MEASURES FOR AIR QUALITY POLICY OPTIONS

CRITERIA	AS APPLIED TO AIR QUALITY	MEASURES
Effectiveness Achievement of policy objective	Is air quality in the West improved or maintained? Is increased energy development allowed? Is the alternative a short- or long-term solution?	Quantitative Emissions per unit of energy production Level of energy production Timing of effects Qualitative Effect on lead times for constructing facilities Extent that conflicts are avoided Extent of environmental impacts
Efficiency Costs, risks, and benefits	What are the economic costs and benefits? Are there additional environmental and social costs or benefits?	Quantitative Dollar costs per unit of energy produced Level of nonair residuals or other impacts Qualitative Acceptability of risks
Equity Distribution of costs, risks, and benefits	How are the costs, risks, and benefits distributed?	Qualitative Regional distribution of air pollution Regional impacts on energy production Distribution of economic costs and benefits
Flexibility Adaptability to locational needs and changes over time	Does the alternative allow for regional differences? Is the alternative reversible?	Qualitative Degree that locational variables are considered Degree of local or state responsibility Ease of reversibility Level of public participation allowed
Implementability Adoptability and acceptability	Will the alternative be difficult to adopt? Will the alternative be difficult to administer?	Quantitative Dollar costs for administration Qualitative Groups likely to be in favor or opposed New laws or institutions required

coal demand.[1] Some of the results of this study are summarized in Table 6-16.

The base case used by Argonne assumes a continuation of the current NSPS for SO_2 of 1.2 lbs/10^6 Btu's. As indicated in the table, a requirement for a 90 percent sulfur reduction would cause demand for Northern Great Plains coal to drop sharply to about 52 percent of the base case by 1990.[2] Almost all of this drop occurs in the shipments from the Northern Great Plains to the East Central demand region (Ohio, Michigan, Indiana, Illinois, and Wisconsin); in 1990 there is a drop in these shipments from 180 million tons per year in the base case to 40 million tons per year in the 90 percent sulfur removal case. This shift is attributable to the fact that once scrubbers are required, it would be less expensive for utilities and industry in the East Central demand region to use local coal. In fact, coal flows from the Northern Great Plains to the East Central region after 1985 are largely the result of contractual supply agreements made before the BACT policy was assumed to take effect. In sum, the Argonne study indicates that BACT will dramatically shift new contracts for the East Central region from western to local coals.

Although the 90 percent sulfur control requirement would apparently result in a dramatic shift in regional coal supply/demand patterns, it should be noted that the data in Table 6-16 indicate a large growth in western coal demand even in the 90 percent sulfur control case. Total western coal demand is projected to be 418.5 million tons per year in 1990 in the 90 percent sulfur removal case (a 294 percent increase above the 1975 level) whereas it would be 592.5 million tons per year in 1990 in the base case (a 458 percent increase above 1975 levels). The effects on demand for western coal in other regions is not likely to be affected significantly according to the Argonne study; Table 6-16 indicates a slight increase in "other western" coal production under the BACT scenario.

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[1] Krohm, G.C., C.D. Dux, and J.C. Van Kuiken. Effect on Regional Coal Markets of the "Best Available Control Technology" Policy for Sulfur Emission, National Coal Utilization Assessment. Argonne, Ill.: Argonne National Laboratory, 1977. The Argonne study examined the effects on regional coal markets of alternative BACT definitions (including the 90 percent sulfur reduction requirement). Argonne utilized a model which simulates the behavior of competitive coal markets and allocates coal from each supply area to each demand area (utility and industrial) in such a way to minimize total market costs. The model considers such factors as coal availability; coal quality (Btu and sulfur content); regionally disaggregated coal supply and demand; mining, transportation, and pollution control costs; etc.

[2] The Argonne analysis showed very similar effects for all of the BACT alternative definitions examined.

TABLE 6-16: REGIONAL STEAM COAL PRODUCTION ESTIMATES
(millions of tons per year)

COAL PRODUCTION REGION	1975 STEAM COAL PRODUCTION	1985		1990	
		BASE CASE	90% SULFUR REMOVAL	BASE CASE	90% SULFUR REMOVAL
Northern Great Plains	46.0	249.3	188.6	387.8	201.6
Other western[a]	106.0	162.5	164.2	204.7	216.9
Total National	499.7	925.1	922.9	1,235.0	1,211.3

Source: Krohm, G.C., C.D. Dux, and J.C. Van Kuiken. Effect on Regional Coal Markets of the "Best Available Control Technology" Policy for Sulfur Emission, National Coal Utilization Assessment. Argonne, Ill.: Argonne National Laboratory, 1977.

[a] The production of the "other western" region comes primarily from Colorado, Utah, Arizona, and New Mexico, but it also includes Texas lignite and middle sulfur coal in Oklahoma, Kansas, Arkansas, and Texas.

Two factors could reduce this dramatic shift from western to east central coal. First, the coal industry may not be able to shift production capacity this rapidly from western mining areas back to the Midwest and Applachian areas. And, second, most western coal is currently produced from nonunionized suface mines; on the other hand, most midwestern and eastern coal is produced by unionized miners. The protracted coal strike of 1977-78 has heightened the concern industrial and utility coal users have about the reliability of coal supplies from unionized mines. This concern may result in a greater demand for western coal than would be expected on the basis of economic cost alone.

Another important factor which makes these calculations uncertain is the degree to which increased pollution control costs for coal-fired power plants will lead utilities to choose nuclear power over coal. As indicated in Table 6-16, the difference in total national coal demand between the base case and the 90 percent sulfur removal case is not very large. However, recent studies[1] have reaffirmed the economic attractiveness of nuclear power for baseload generation; and since the BACT requirement should enhance the nuclear cost advantage, it could lead to substantial overall reduction in coal demand.[2]

(2) What Will be the Effect on SO_2 Emissions?

The other aspect of effectiveness important for this alternative is the impact it would have on air pollution levels both within and outside the eight-state study area. This question has been examined in a contract study of alternative NSPS definitions performed for EPA.[3] Table 6-17 presents some of the results of this study which was based on a "moderate" energy demand growth rate (5.8 percent annually through 1985 and 3.4 percent annually thereafter). The regions used in this report do not correspond precisely with our eight-state study area, but the findings of

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[1] See for example, Rudasill, Charles L. "Comparing Coal and Nuclear Generating Costs." EPRI Journal, Vol. 2 (October 1977), pp. 14-17.

[2] Krohm, G.C., C.D. Dux, and J.C. Van Kuiken. Effect on Regional Markets of the "Best Available Control Technology" Policy for Sulfur Emission, National Coal Utilization Assessment. Argonne, Ill.: Argonne National Laboratory, 1977, p. 49-51.

[3] Teknekron, Inc. Review of New Source Performance Standards for Coal-Fired Utility Boilers, Volume I: Emissions and Non-Air Quality Environmental Impacts. Berkeley, Calif.: Teknekron, 1978. For this analysis Teknekron utilized their Utility Simulation Model, a computer model which simulates the response of the policies and regulatory constraints.

TABLE 6-17: REGIONAL SULFUR DIOXIDE EMISSION ESTIMATES FROM POWER PLANTS[a] (million metric tons per year)

REGION	1976	1985		1995	
		BASELINE	90% SULFUR CONTROL	BASELINE	90% SULFUR CONTROL
North Mountain[b]	0.12	0.09	0.06	0.18	0.06
South Mountain[c]	0.34	0.23	0.19	0.28	0.16
U.S. Total	13.6	15.2	15.2	15.8	13.6

Source: Teknekron, Inc. Review of New Source Performance Standards for Coal-Fired Utility Boilers, Volume I: Emissions and Non-Air Quality Environmental Impacts. Berkeley, Calif.: Teknekron, 1978, pp. 3-12 through 3-15.

[a] Based on "moderate" electricity demand growth: 5.8 percent per year through 1985 and 3.4 percent per year between 1985-2000.

[b] Consists of Idaho, Wyoming, and Montana.

[c] Consists of Nevada, Utah, Colorado, Arizona, and New Mexico.

this study do suggest what the impact of the 90 percent SO_2 control requirement might be on this area.

As indicated in Table 6-17, Teknekron's study shows that a 90 percent SO_2 control requirement would have a large relative effect on the emission levels in the mountain regions; e.g., emission levels are reduced 43 percent and 67 percent by 1995 in the South Mountain and the North Mountain regions respectively. However, equally important are the low emissions for the Mountain regions in the baseline case as compared to the U.S. total. For example, the Mountain regions in the baseline case for 1995 account for only about 3 percent of the total U.S. SO_2 emissions, and yet the capacity of coal-fired power plants for the Mountain region is 7.7 percent of the U.S. total. The reasons for this low baseline emissions rate for the Mountain region are the availability of low-sulfur coal, the already strict state emissions standards, and federal ambient air quality standards (e.g., PSD) that result in relatively tight SO_2 controls for many plants even in the baseline case. The strict controls required without BACT were indicated previously in Table 6-4. The reason for the large percentage difference between the baseline and 90 percent control cases for the Mountain region is that given stringent controls, tightening them even slightly results in a relatively large percentage reduction in emissions; for example, a tightening of SO_2 percentage removal rates from 80 to 90 percent means a 50 percent reduction in emissions. In sum, the 90 percent SO_2 control alternative shows a large relative drop in total SO_2 emissions in the West, but in fact the standard would not, in general, be significantly more strict than emission limits already imposed by many western states or emission limits likely to be required on many plants in order to meet PSD or new visibility standards.

In terms of national emissions, the data in Table 6-17 show emissions reductions by 1995 of 2.2 million metric tons per year relative to the baseline (a 14 percent drop).

One important disadvantage of this alternative may not be fully accounted for in the above calculations. The 90 percent sulfur control requirement provides no incentive whatsoever for utilities to burn coals with a low or moderate sulfur content. Under this alternative, they will be encouraged to seek the lowest priced coal as long as 90 percent sulfur control will keep SO_2 emissions below 1.2 lbs/10^6 Btu's.

(3) How Will Electricity Prices Be Affected?

The Teknekron study cited earlier also examined the effects of this alternative on electricity prices.[1] Table 6-18 presents projected real prices (1975 dollars) for the "baseline" and "90 percent SO_2 control" cases. Tighter SO_2 and particulate controls are expected to increase electricity prices 0.05 cents/kWh nationally (a 1.7 percent increase) in 1995. For the two Mountain regions, the real price increases in 1995 are slightly larger--0.07 cents/kWh for the North Mountain region (a 3.5 percent increase) and 0.1 cents/kWh for the South Mountain region (a 3.75 percent increase).

As noted above, the 90 percent sulfur reduction requirement provides no incentive for seeking low sulfur coals. Therefore, this approach is inefficient since the same emissions levels could be achieved at a lower economic cost by utilizing low sulfur coals in conjunction with a lower percentage removal standard.

(4) Are There Other Costs or Benefits?

An across-the-board 90 percent sulfur control requirement could have an adverse "efficiency" impact by limiting new, innovative approaches for SO_2 control. The only demonstrated

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[1] Teknekron, Inc. Review of New Source Performance Standards for Coal-Fired Utility Boilers, Volume II: Economic and Financial Impacts. Berkeley, Calif.: Teknekron, 1978.

TABLE 6-18: ELECTRICITY PRICE IMPACTS OF 90 PERCENT SULFUR DIOXIDE CONTROL: MODERATE GROWTH SCENARIO[a] (cents per kilowatt hours: 1975 dollars)

REGION	1985		1995	
	BASELINE	90% CONTROL[b]	BASELINE	90% CONTROL[b]
North Mountain	2.30	2.31	2.02	2.09
South Mountain	2.67	2.82	2.67	2.77
United States	2.81	2.85	2.93	2.98

Source: Teknekron, Inc. Review of New Source Performance Standards for Coal-Fired Utility Boilers, Volume II: Economic and Financial Impacts. Berkeley, Calif.: Teknekron, 1978, p. 3-20.

[a] The "moderate electricity demand growth scenario" assumes a 5.8 percent annual increase through 1985 and 3.4 percent annually between 1985 and 2000.

[b] The 90 percent sulfur dioxide control scenario also includes a tigntening of the particulate standard from 0.1 pounds per 10^6 British thermal units (lbs/10^6 Btu) to 0.03 lbs/10^6 Btu's. The tighter particulate standard also contributes to the price increases shown in this table, but the great bulk is due to the sulfur dioxide removal requirement.

technology for achieving 90 percent reduction is throwaway FGD,[1] either alone or in combination with some physical coal cleaning. Other sulfur control technologies being developed include regenerable FGD, chemical coal cleaning, fluidized bed combustion, and low-Btu gasification/combined-cycle power plants. It is not certain that these new technologies can achieve a 90 percent reduction standard; thus industry may be reluctant to take the risk of failure. EPA may need to develop some special procedures that would not penalize industry for attempting innovative solutions to the SO_2 control problem.

The use of currently available throwaway FGD processes also creates a number of other environmental problems, including the disposal of large amounts of sludge wastes, increased water

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[1] With throwaway FGD, the used scrubbing material (a wet sludge) must be disposed of. In contrast, with regenerable FGD the scrubbing material is recycled, reducing a much smaller amount of waste and some useful byproducts (e.g., elemental sulfur or sulfuric acid).

TABLE 6-19: PROJECTIONS OF SLUDGE PRODUCED AND WATER CONSUMED BY FLUE GAS DESULFURIZATION SYSTEMS: 1995, HIGH DEMAND SCENARIO[a]

REGION	SLUDGE PRODUCED (millions metric tons per year, dry basis)		WATER CONSUMED[b] (acre-feet per year)	
	BASELINE	90% CONTROL	BASELINE	90% CONTROL
North Mountain	.18	1.3	5,430	25,800
South Mountain	.76	1.8	18,300	37,600
Nation	12.0	55.0	89,100	491,000

Source: Teknekron, Inc. Review of New Source Performance Standards for Coal-Fired Utility Boilers, Volume I: Emissions and Non-Air Quality Environmental Impacts. Berkeley, Calif.: Teknekron, 1978, pp. 3-23 through 3-28.

[a] High demand growth scenario assumed 5.8 percent per year through 1985 and 5.5 percent per year thereafter.

[b] This is the make-up water (or the flue gas desulfurization system). It does not include increased water consumption for cooling due to lowered efficiencies.

consumption, and lowered energy efficiencies due to the energy requirements of the scrubbers. Table 6-19 gives estimates of the sludge that will be produced and the water that will be required in 1995 for the base case and the 90 percent sulfur removal requirement.[1] These data show large relative increases in solid waste disposal and water consumption under the 90 percent sulfur control option, both for the West and nationally. The land requirements for sludge disposal should not be a significant problem for the West, but they do create the threat of water pollution, as discussed in Chapter 5. While the water consumption increases are relatively large, these amounts represent only a small fraction (around 5 percent) of that required for cooling.

In terms of energy efficiency, Teknekron estimates that, in the 90 percent control case, 3.8 percent of the coal energy consumed will go to operate the FGD systems. This compares with a 0.71 percent figure for the baseline case.[1]

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[1] Teknekron, Inc. Review of New Source Performance Standards for Coal-Fired Utility Boilers, Volume I: Emissions and Non-Air Quality Environmental Impacts. Berkeley, Calif.: Teknekron, 1978, pp. 3-23 through 3-28.

(5) How Are Costs and Benefits Distributed Regionally?

The legislative history of the 1977 Amendments makes it clear that one of the purposes of the BACT requirement was to redress an inequity caused by the existing NSPS which gave low-sulfur western coal a competitive advantage. That is, the intent was to put western coal on a more equal footing with midwestern and eastern coal. As indicated previously, this alternative does this by substantially shifting the demand from western to east central coal. The incremental electricity price increases due to this requirement have been shown to be about twice as high in the western region as nationally--about 3.5 percent in the West compared to 1.7 percent nationally.

In looking at the distribution of impacts among the states in the eight-state study area, the equity question needs to be looked at in both environmental and economic terms. Some states in the West have much stricter emission and ambient air quality standards than do others. Since air pollutants do not respect state borders, this can become the basis for conflict. The states with less stringent standards have some economic advantage in attracting industry and yet the "clean-air state" could suffer air degredation from energy facilities near their border or via the long range transport of pollutants. The mandatory 90 percent SO_2 removal requirement would remove the environmental and economic inequities by requiring all states to control SO_2 to approximately the same degree. Of course, it does this by taking away from states the right to set emission standards as they wish and on the basis of what they consider to be in their own best interest.

(6) Are Utilities or Investors Affected Financially?

Another aspect of "equity" to be considered is the economic impact of the 90 percent SO_2 control requirement on the utility industry. In principle, regulators allow utilities to set prices just high enough so that revenue collected will equal the costs of providing service (including an appropriate return on investment). In practice, ratemaking is subject to "regulatory lag," i.e., rates are adjusted to current circumstances only once every few years. And although the full cost of such equipment as FGD units is supposed to be borne by the utility customers, regulatory lag often results in utility investors receiving less than the allowed rate of return as long as intensive construction schedules persist.

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[1] Teknekron, Inc. Review of New Source Performance Standards for Coal-Fired Utility Boilers, Volume I: Emissions and Non-Air Quality Environmental Impacts. Berkeley, Calif.: Teknekron, 1978, pp. 3-30 and 3-31.

TABLE 6-20: RETURN ON EQUITY FOR ELECTRIC UTILITIES UNDER ALTERNATIVE SCENARIOS, 1985-1995 (percent) (moderate electricity demand growth rate)

	NATION	NORTH MOUNTAIN	SOUTH MOUNTAIN
Baseline	12.4	16.5	13.2
90% standard	11.9	13.9	12.7
Difference	.5	2.6	.5

Source: Teknekron, Inc. Review of New Source Performance Standards for Coal-Fired Utility Boilers, Volume II: Economic and Financial Impacts. Berkeley, Calif.: Teknekron, 1978, p. 3-37.

Teknekron has estimated the investor-borne costs associated with a 90 percent sulfur removal standard.[1] Two measures employed, both considered important by participants in capital markets, are summarized in Tables 6-20 and 6-21. It was assumed that return on equity--the annual profit per dollar investment of the shareholder--is targeted at 13 percent by the regulatory authorities. As can be seen in Table 6-20, the average utility in the nation will probably not achieve the allowed rate of return even in the baseline scenario. Imposition of the 90 percent sulfur removal

TABLE 6-21: INTEREST COVERAGE RATIOS FOR ELECTRIC UTILITIES UNDER ALTERNATIVE SCENARIOS, 1985-1995 (moderate electricity demand growth rate)

	NATION	NORTH MOUNTAIN	SOUTH MOUNTAIN
Baseline	3.14	4.38	3.42
90% standard	3.14	4.36	3.31
Difference	0	.02	.11

Source: Teknekron, Inc. Review of New Source Performance Standards for Coal-Fired Utility Boilers, Volume II: Economic and Financial Impacts. Berkeley, Calif.: Teknekron, 1978, p. 3-39.

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[1] Teknekron, Inc. Review of New Source Performance Standards for Coal-Fired Utility Boilers, Volume I: Economic and Financial Impacts. Berkeley, Calif.: Teknekron, 1978, p. 3-39.

standard would double that discrepancy for the nation as a whole (1.1 percentage points versus 0.6). The North Mountain states would experience a much larger effect from the sulfur standard, but these utilities would still end up with a higher-than-allowed rate of return.

Table 6-21 expresses the returns to capital in terms which highlight risks to lenders. The interest coverage ratio,

$$\frac{\text{earnings + interest payments}}{\text{interest payments}}$$

shows the safety margin which protects lenders in the face of the utility's unpredictable earnings. Utilities often enter into agreements with bond buyers not to extend their debt any further if the interest coverage ratio falls below 2.0 to 1.75 range. Table 6-21 shows that the proposed sulfur standard does not move utilities very far toward ratios which would be considered financially risky. There is essentially no effect nationally or in the North Mountain region.

In sum, Teknekron's modeling results indicate that, in a context of regulatory lag, utility shareholders will bear a measurable amount of costs due to implementing a sulfur control standard. The actual effect on shareholders will probably exceed that indicated by this model, since it assumes annual ratemaking reviews, whereas in practice comprehensive reviews and adjustments normally occur only once every two or three years. Nevertheless, the extra cost borne by investors will not be large enough to have much affect on the credit rating of the average utility.

(7) Is the Alternative Flexible and Easy to Implement?

The 90 percent SO_2 control requirement would not satisfy a flexibility criterion since it sets an across-the-board requirement and does not allow for setting SO_2 emissions limitations based on the circumstances unique to different regions.

In a procedural sense, this alternative would be easy to implement under the provisions of the 1977 CAA Amendments. However, the standard could result in some very practical difficulties for EPA monitoring activities. It would require EPA to monitor both emission rates and effectiveness of sulfur removal systems. In measuring the percentage of sulfur removal, EPA would have to monitor both coal cleaning plants and FGD systems. No information was available on the economic costs of these increased monitoring tasks.

(8) Summary of BACT Alternative

Table 6-22 summarizes the findings just presented for the policy alternative of requiring 90 percent sulfur control on all new, large coal burning facilities. Very briefly, on the positive

TABLE 6-22: SUMMARY OF EVALUATION OF BEST AVAILABLE CONTROL TECHNOLOGY DEFINITION

CRITERIA	MEASURE	FINDING
Effectiveness Achievement of policy objective	Level of energy production	One study projects almost a 50 percent drop by 1990 in western coal production compared to projections without BACT. Most of the reduction occurs in coal flows from Northern Great Plains to East Central region. However, western coal production still grows almost 300 percent above the 1975 level. Projections are especially uncertain due to possible supply interruptions from unionized eastern mines and the possibility of increased control causing a substitution of nuclear power for coal.
	Air emissions per unit of energy production	By 1995, SO_2 emissions from power plants should drop 43 percent and 67 percent in the South Mountain and North Mountain regions respectively, relative to the case without BACT. However, baseline emissions are relatively small due to strict state emission standards and PSD regulations. Nationally by 1995 SO_2 emissions should decrease 14 percent relative to the case without BACT.
	Timing of effects	Since BACT will only apply to plants beginning construction after mid-1978, this alternative will produce effects only in the mid- and long-terms.
Efficiency Costs, risks, and benefits	Costs of electricity	By 1995 relative to non-BACT case the 90 percent sulfur control requirement is projected to increase electricity prices about 3.5 percent in the western region and about 1.7 percent nationally. However, the same emission levels could be achieved more economically by encouraging use of low sulfur coals.
	Level of nonair residuals or other impacts	Current FGD processes for controlling sulfur emissions produce large amounts of sludge (as much as 3.1 million metric tons by 1985 in the West), increase water consumption (although the percentage increases are small), and decrease electric generation efficiency (approximately 3.8 percent of the coal energy consumed will go to operating the FGD equipment).

TABLE 6-22: (Continued)

CRITERIA	MEASURE	FINDING
Equity		
Distribution of costs, risks, and benefits	Regional impacts on energy production	Achieves national policy objective of putting western coal on more equal footing with interior and eastern coals.
	Distribution of economic costs and benefits	Incremental electricity price increases are about twice as high for the West as nationally--3.5 percent versus 1.7 percent. Due to "regulatory lag," utility investors will bear a measurable amount of the increased costs.
	Regional distribution of air pollution	Equalizes emissions rates among states.
Flexibility		
Adaptability to locational needs and changes over time	Degree that locational variables are considered	No locational variables considered; instead, sets a uniform national standard.
	Degree of state or local responsibility	No local or state control.
Implementability		
Adoptability and acceptability	New laws or institutions required	Implementation straightforward under 1977 Clean Air Act Amendments.
	Dollar costs of administration	Creates practical difficulties for EPA monitoring; requires measuring sulfur removal percentages in addition to emission rates, and requires monitoring of coal cleaning plants in addition to power plants. No dollar cost estimates are available for these expanded activities.

BACT = best available control technology
SO_2 = sulfur dioxide
PSD = prevention of significant deterioration
FGD = flue gas desulfurization
EPA = Environmental Protection Agency

side this alternative will contribute to a reduction in SO_2 emission rates, although in the West strict state standards and PSD regulations mean that relatively strict controls would be required anyway. It will also help achieve the national goal of shifting demand from western coal back to eastern and interior coals, while allowing for an almost 300 percent growth in western coal production between 1975 and 1990. Emission rates among the states will be equalized, thus reducing the potential conflicts between "clean-air" states and "prodevelopment" states. Implementation of this alternative could be achieved directly under the requirements of the 1977 CAA Amendments.

On the negative side, electricity prices are projected to increase 1.7 percent nationally and about 3.5 percent for the West; the approach is inefficient since the same emission levels could be achieved with lower costs by giving credit for the use of low sulfur coals. Due to regulatory lags some measurable proportion of these increased costs will be borne by utility investors rather than by consumers. There are a number of environmental costs with currently available throwaway FGD processes: large amounts of sludge wastes, some increase in water consumption, and a lowered power plant efficiency of almost 4 percent. The alternative would also present some enforcement difficulties for EPA; it would require monitoring coal cleaning plants and measuring both emission rates and overall sulfur removal percentages.

C. Evaluation of the Smaller, Dispersed Energy Facilities Alternative

In evaluating this specific alternative, it will be assumed that the basic hardware will be the same in the single, large plant case and the dispersed, smaller plant case. For example, with coal-fired power plants a single large plant of say 1,500 MWe capacity might consist of three 500 MWe units, with each unit made up of a boiler, turbine, generator, and cooling tower.[1] Under the smaller, dispersed facilities alternative, the basic units would simply be dispersed rather than being built side by side.

It is interesting to note that the general approach suggested by this specific alternative is receiving considerable attention from both utilities and government. For example, the New York Public Service Commission has required a utility to examine the pros and cons of building 300 to 600 MWe facilities instead of the more conventional strategy of relying on 900 to 1,200 MWe plants. The commission stated: "It has been conventional system planning wisdom for a long time that construction of plants of ever increasing capacity is desirable (1) to achieve scale economies, and (2) to reduce the environmental impact associated with siting a number of smaller generating plants. We believe these arguments must now be reexamined in light of current conditions and future prospects."[1] There are also two major research projects currently underway which are comparing the environmental and economic tradeoffs between large versus small power plants, one at Los Alamos Scientific Laboratory (sponsored by EPA), and one at the Electric Power Research Institute.[2] When the results of these studies are completed, considerably better information will be available than now exists.

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[1] With other types of cooling systems, such as once-through cooling or cooling ponds, the three units might actually share the same cooling systems rather than having three distinct systems.

(1) Will Increased Western Energy Development Be Allowed?

As was indicated previously in Section 6.2.1.A., only coal conversion facilities (especially power plants) and oil shale plants face serious size restrictions due to ambient air quality standards. However, there is little flexibility in siting oil shale facilities due to the concentration of the resources in a relatively small geographical area and the impracticality of shipping the raw shale for retorting at a distant location. Therefore, the smaller, dispersed facilities option is primarily of interest for coal. Because coal resources are widely distributed throughout the eight-state study area and because it is economically feasible to ship coal some distance from the mine for conversion, there is considerable flexibility in coal conversion facilities siting.

Even if plants meet strict BACT emission restrictions, air quality regulations (i.e., NAAQS, PSD, or state standards), can restrict the siting of large energy facilities. As indicated previously in Section 6.2.2, the maximum size allowed will depend on such factors as the emission rates of the various air pollutants, terrain, meteorological conditions in the vicinity of the site, and proximity to PSD Class I areas. Where large facilities are prohibited because of air quality regulations, the approach suggested by this alternative is to build the same desired total capacity in smaller units dispersed over a large enough area so as to minimize significant air pollution interactions. This would reduce air pollution concentration levels thus helping to avoid energy growth restrictions.

Because it is assumed that the same basic hardware is being used in both cases, the total emissions will be the same regardless of the plant siting strategy. Thus, region-wide air impacts or impacts from the long-range transport of pollutants would not be significantly different under this alternative.

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[1] New York Public Service Commission. Opinion Analyzing Plans Pursuant to Section 149-b of the Public Service Law and Order Directing Additional Studies, Opinion No. 78-3, Case 27154--Long Range Electric Plans. Albany, N.Y.: Public Service Commission, March 6, 1978.

[2] Ford, Andrew, Los Alamos Scientific Laboratory, and Wyzga, Ronald E., Electric Power Research Institute. Personal communications, May 1978.

In addition to air quality considerations, the smaller facilities approach could also alleviate siting difficulties caused by limited water resources since the smaller plants will consume proportionately less water than large facilities. For example, smaller facilities could be sited near small rivers where it might not be feasible to site a plant three or four times larger.

One potential drawback of this alternative in terms of its effect on levels of energy development has to do with the siting process. As discussed in Chapter 12, obtaining permits and meeting other regulatory requirements can be a very time consuming, expensive, and frustrating process. The smaller facilities alternative increases the number of siting applications a developer would have to make, including acquiring more sites, possibly preparing more environmental impact statements, and obtaining more permits. This could potentially "clog" the system, thereby slowing energy development activities. However, this consequence might be avoided, particularly since the concentration of negative environmental impacts would generally be far less for the smaller facilities. For this reason, they might face less opposition, thereby easing the siting process for each small facility compared to a much larger one.

(2) Are There Economic Costs or Benefits Associated with this Option?

The economic trade-offs between the large vs. smaller facilities strategy depends on a large number of factors which can be dealt with in detail only in a specific case-by-case basis. For power plants, it is clear that utilities came to believe that very large facilities offered an economy of scale advantage. However, this thinking has begun to be questioned for a variety of reasons, some of which will be discussed in this section. The general trade-offs involved for electric power plants will be highlighted. Similar considerations apply to other types of energy conversion facilities although the specifics would, of course, vary.

There is little question that the large power plant strategy offers capital cost advantages on a dollar per kilowatt-hour (kw) capacity basis. Assuming that the basic hardware (i.e., boilers, turbines, and generators) are the same regardless of facility size, the capital costs for these items would be approximately the same (the labor costs for construction might be lower for the large plant option). However, the smaller facilities option would have some diseconomies associated with coal handling equipment and land. For example, three separate facilities would require from 2 to 2.5 times as much land (depending on the type of cooling system) as a large facility.[1] The results of one study indicate that overall three separate 700 MWe units would have a 20 percent higher capital cost than a single 2,100 MWe plant.[2]

The smaller, dispersed facilities option would also have some operating cost disadvantages since single, large plants require fewer operations personnel on a per kw basis. Coal supply costs (including transportation) could also be higher with the smaller facilities option, although this would depend on many site specific factors, such as the location of potential coal supply sources relative to the plant sites and the availability of existing rail lines.

Another possible diseconomy associated with the smaller, dispersed facilities option would be the energy delivery system (e.g., electric transmission lines or gas pipelines). These energy transportation systems offer significant economies of scale. For example, an electric transmission line capable of handling 500 MWe would cost approximately 30-40 percent more on a per kWh per mile basis than a line capable of handling 1,500 MWe.[3] The net effect on energy delivery costs would depend on a variety of considerations such as the location of a site in relation to the demand center and the availability of transportation rights-of-way. If the smaller facilities option allowed the plants to be located closer to the demand centers, this option might well have the lowest energy delivery costs.

Depending on how the construction of units is timed, the smaller facilities option could offer certain economic advantages which would outweigh the higher capital and operating costs. If the large plant is constructed in such a way as to bring all of its units on line simultaneously, the total elapsed time from the decision to proceed to commercial power production may range from about 9.5 to 12 years. The equivalent time period for a small plant would be from 5.5 to 7.5 years. The shorter planning period for small plants reduces the uncertainty of forecasting electricity demand and thus reduces the likelihood that a utility will be caught with capacity excesses or shortages. Also, the shorter lead time for smaller facilities means that the financial burden of carrying a large amount of "construction work in progress" would be reduced.[1]

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[1] Wyzga, Ronald E. "Concentrated vs. Large Dispersed vs. Dispersed vs. Atomized Power Plants-Overview." Paper presented at Engineering Foundation Conference on Non-conventional Siting of Power Plants, Henniker, New Hampshire, July 10-15, 1977.

[2] Ibid.

[3] Calculated from U.S., Federal Power Commission. 1970 National Power Survey. Washington, D.C.: Government Printing Office, 1971, Vol. I, p. 13-9, as cited in U.S., Congress, Senate, Committee on Energy and Natural Resources and Committee on Commerce, Science, and Transportation. National Energy Transportation, Vol. I: Current Systems and Movements, Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977, p. 357.

In sum, it is not possible to state categorically that the smaller, dispersed facilities option is either more or less economically attractive than building a single large plant. The economic trade-offs would depend on many factors that could only be evaluated precisely on a case-by-case basis.

(3) Are There Other Environmental or Social Effects?

The construction of smaller, dispersed energy facilities could have an important effect on the level of social and economic impacts. Small facilities will generally have a larger peak labor force on a per unit of energy basis than a larger facility. For example, one estimate is that a 500 MWe power plant would have a peak construction requirement of 650 persons (1.3 persons per MWe) while a 3,000 MWe plant would only have a peak construction force of 2,850 (.95 persons per MWe).[2] However, if the smaller facilities are built sequentially or are separated enough so that population impacts fall on different communities, the "boomtown" effects discussed in our impact analysis report[3] and chapters 8 and 9 of this report could be reduced significantly.

Two potential negative environmental impacts of the smaller facilities option are difficult to quantify. First, the smaller facilities approach will require more land for the facilities themselves (as indicated previously, on the order of 2 to 2.5 times as for the same total capacity in 700 MWe power plant units as opposed to a single 2,100 MWe facility). However, given the vast land resources in the eight-state study area, this is not necessarily a significant factor. The second area of concern is that the smaller facilities could possibly lead to a greater proliferation of power lines which not only require more land for rights-of-way but also have negative aesthetic impacts. However as mentioned earlier in connection with transportation economics, it is not possible to generalize these factors since they will depend upon so many case-specific variables.

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[1] Ford, Andrew. "Expanding Generating Capacity for an Uncertain Future: The Advantage of Small Power Plants." Paper presented at the Conference on Simulation, Modeling, and Decision in Energy Systems, Montreal, Canada, June 1, 1978.

[2] Ford, Andrew, Los Alamos Scientific Laboratory. Personal communication, May 1978.

[3] White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, 1977, forthcoming.

(4) Are There Equity Considerations?

One disadvantage of the very large energy facilities approach is that such facilities concentrate most of the associated adverse environmental and social impacts in a very small area. In addition, once the facility is on-line and population levels stabilized, overall tax benefits, particularly benefits for counties, will often greatly exceed that governmental unit's needs. For example, in Rosebud County, Montana, the school districts are expected to enjoy substantial financial surpluses if current tax rates are maintained.[1] This can create serious equity problems if many of the energy facility employees live in other counties or in municipalities which do not receive these tax benefits.[2]

The smaller, dispersed energy facilities alternative could alleviate some of these inequities. Impacts would be distributed more widely and, as noted previously, the undesirable social and economic effects caused by "boomtown" conditions would be reduced. Also, if the smaller facilities are sited in different towns or counties the tax benefits would be more evenly ditributed over the region.

(5) Is the Alternative Flexible?

The flexibility of this policy alternative depends on the specific implementation strategy followed. As indicated above, the pros and cons of the smaller facilities alternative are not clear-cut and can vary significantly from case to case. For this reason, any implementation strategy for this approach should be flexible enough to allow the alternative to be considered on a case-by-case basis.

One implementation strategy which gives flexibility without ignoring possible benefits would be for state utility commissions to require industry to evaluate the smaller, dispersed facilities approach explicitly in their planning. (This is the tack taken by the New York Public Service Commission.)[1] Alternatively, federal agencies could require that this option be considered explicitly in the alternatives section of environmental impact statements for new energy facilities. These approaches would not necessarily force industry to choose the option, but they would force them to look at it. In the process, more information would be made publicly available about possible costs and benefits of smaller, dispersed facilities.

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[1] White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Section 10.4.6.

[2] As noted in Chapters 8 and 9, the revenues problem has two elements, timing and distribution. First, early in a development, all affected governmental units experience a revenue shortfall unless special programs have been initiated to prevent this from occurring; and second, some governmental units, particularly municipalities, usually have to meet the major services and facilities needs but do not receive a very large share of the revenue benefits associated with development.

(6) Would the Option Be Easy to Implement?

One implementation strategy suggested above was to require industry to consider the smaller, dispersed facilities approach in its planning and environmental impact statements. This would be easy for utility commissions and federal agencies to implement if they were convinced that the ideas warranted serious consideration. Of course, this approach is based on being flexible and not necessarily "forcing" the developer to choose the smaller facilities approach; and, therefore, this approach would not ensure that the small facilities alternative is ever implemented.

More covert actions would be taken to force the construction of smaller, dispersed facilities through such means as a graduated emissions tax or a government prohibition on facilities above a certain size. However, these implementation strategies would require new laws and would likely be strongly resisted by industry.

(7) Summary of Evaluation for Smaller Facilities Alternative

Table 6-23 summarizes the findings for the policy alternative of constructing smaller, dispersed energy facilities. This approach offers the potential for contributing to the achievement of the stated policy objective, but it also has several possible drawbacks. The net effect will depend on a variety of case specific factors so that generalizations are not possible. By reducing plant size, negative impacts are diluted: peak air pollution concentration levels, water requirements, and "boomtown" impacts are all reduced. Lead times for construction could also be reduced by as much as 50 percent. For these reasons, siting a small facility should be easier, thus possible allowing for more rapid energy development. Also, tax and other economic benefits would be more uniformly distributed in the region.

On the other hand, capital and operating costs will be somewhat higher for small facilities, although these possibly could be

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[1] New York Public Service Commission. Opinion Analyzing Plans Pursuant to Section 149-b of the Public Service Law and Order Directing Additional Studies, Opinion No. 78-3, Case 27154--Long Range Electric Plans. Albany, N.Y.: Public Service Commission, March 6, 1978.

TABLE 6-23: SUMMARY OF EVALUATION OF SMALLER FACILITIES ALTERNATIVE

CRITERIA	MEASURE	FINDING
Effectiveness Achievement of policy objective	Emissions per unit of energy production	No direct effect on emission rates.
	Level of energy production	Net effects are uncertain. By reducing the concentration of negative impacts, including air pollution concentration levels, water consumption, and boomtown effects, there should be more sites available for energy facilities and fewer difficulties encountered in siting each one. On the other hand, increasing the number of sites that have to be obtained could slow development.
	Effect on lead times for construction facilities	Could be reduced from the 9-1/2 to 12 years for large plants to 5-1/2 to 7-1/2 years.
Efficiency Costs, risks, and benefits	Dollar costs per unit of energy produced	Net effect is uncertain. Plant capital and operating costs somewhat higher for smaller facilities. However, shorter lead times will reduce the costs of forecasting errors and the financial burden of "construction work in progress." Costs of transportation of energy to the plant and to the consumer will depend on many site-specific factors.
	Level of nonair residuals or other impacts	Land use for plants will double or triple. Some effect on transportation land use but the direction and magnitude depends on specific circumstances. No direct effect on other residuals. Boomtown effects are reduced.
Equity Distribution of costs, risks, and benefits	Regional distribution of air pollution	Air pollution would be distributed over the region more widely rather than being concentrated in a few areas.
	Distribution of economic costs and benefits	Depending on site selection, tax and other positive economic benefits could be distributed more evenly across the region.
Flexibility Adaptability to locational needs and changes over time	Degree that locational variables are considered	Flexibility depends on specific implementation strategy. Since pros and cons of this alternative depend on many factors, it is advisable not to force it across-the-board. It could be encouraged by state utility commissions in planning requirements or by federal government in environmental impact statement requirements.
Implementability Adoptability and acceptability	Groups likely to be in favor or opposed	Industry is very likely to oppose any mandatory program for smaller facilities.

offset by reducing the costs of excess or inadequate capacity due to demand forecasting errors and by reducing the financial costs of carrying large amounts of "construction work in progress." Also, the larger number of plant siting procedures could possibly slow energy development. Land requirements for the smaller plants will be 2 to 3 times larger, while land use for energy transportation systems will depend on the relative location of raw energy production sites, the plant sites, and the energy demand points.

Since the net balance of the various pros and cons will vary on a case-by-case basis, it is not advisable to force this policy alternative across-the-board. However, state utility commissions or the federal government could encourage this alternative by requiring that industry consider it in their planning, and in the process much more detailed information would be generated about the costs and benefits of this approach.

D. Evaluation of Commercialization Programs

The threat to western air quality from large scale energy development could be significantly reduced if cleaner production technologies presently being developed prove out and become available to be utilized commercially. Thus, there are advantages for the West in a policy alternative which rapidly moves new, clean technologies through the research, development, and demonstration (RD&D) phases to a point where they are commercially available in the short term, that is, within the next 10 years. This means efforts should focus on processes currently ready or which will soon be ready for construction of commercial-scale demonstration plants.

Commercial-scale demonstrations represent the final stage in a scaling-up process and should take place only after the technology is well understood. Such demonstrations serve to determine what the performance characteristics will be with scale-up (e.g., air emissions and efficiency) as well as to help identify market demand and other important factors which need to be known to inform decisions on whether to adopt the technology.[1] Impacts of particular concern in the West should be air quality, water consumption, and labor (population) impacts.

Given the high cost of commercial demonstration projects (as much as $1 billion for coal synthetic projects), major federal funding might be essential. At the same time, the need to demonstrate the air quality advantages to western states and interest groups requires that they be included in the planning and execution of a demonstration program focused on the West. Thus, such a demonstration program must involve at least four different categories of participants: the federal government, the western states, western energy resource developers, and other affected interest groups such as environmentalists, consumers, and agriculturalists.

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[1] Baer, Walter S., Leland L. Johnson, and Edward W. Merrow. Analysis of Federally Funded Demonstration Projects: Final Report, for U.S., Department of Commerce, Experimental Technology Incentive Program. Santa Monica, Calif.: Rand Corporation, 1976.

Several possible strategies can be used to implement such a program. It might be accomplished either by having the Department of Energy establish a continuing committee or commission which involves these interests, or by establishing a program within an organization of the western states such as the Western Governors' Policy Office. The committee approach would likely be easier to manage, but would not be as likely to build a regional base of support for the commercialization program as the link with the regional organization.

(1) Is the Alternative Effective?

Tables 6-1 and 6-2 in this chapter listed the air emission rates for the various technologies considered in this study. As was discussed, many of these energy resource development systems have fewer air emissions per unit of energy produced than conventional coal-fired power plants. In addition, other new energy conversion technologies which offer the potential for low air emissions are not considered in this study. These include fluidized bed combustion, low-Btu gasification/combined cycle power plants, and solvent refined coal plants.

Of course, technologies cannot be ranked solely on the basis of air emissions and air quality impacts. Economic costs are crucial in any situation, while water consumption and labor requirements are especially important in the West. A broad comparison of the energy resource development systems considered in this study is given in Chapter 13. Since considerable uncertainty surrounds the cost and impact characteristics of any new technology, no options are clearly superior to conventional coal-fired power plants in all respects. However, several offer potential advantages for the West; for example, coal synthetic fuel processes generally emit fewer air pollutants and require less water than coal-fired power plants. The major current uncertainty with regard to these technologies is their economics. A demonstration/commercialization effort which will improve the available data on these newer technologies and, thereby, possibly insure or speed their commercialization would be an effective policy alternative for protecting western air quality while still allowing western energy resources to be developed.

However, there remains the question of just how effective an expanded RD&D program would be in insuring or speeding the development of these new technologies. Of course, such a question can not be answered precisely since the uncertainty surrounding the technologies is what leads to the demonstration requirement. Some of the potentially attractive processes are currently considered to be technically available but they are not being commercially developed in the United States. For example, the Lurgi and Koppers-Totzek coal gasification processes are being utilized commercially in other countries, but their commercial development has been slow in this country. Several commercial-scale coal liquefaction, coal gasification, and oil shale projects have been in the discussion stage for at least the past five to ten years, but few are currently being constructed and none are yet in operation. The reasons for this are primarily due to uncertainties in production costs, future market prices for oil and gas which are largely controlled by OPEC, and environmental impacts and regulations. Many of these synthetic fuel processes are ready now for commercial-scale demonstration. For other technologies, such as liquid-dominated geothermal, there is also the possibility of demonstration plants in the near future, although some further development work may be needed to test out alternative process designs. In short, while the effectiveness of a well-designed RD&D program cannot be predicted with certainty, it is probably safe to state that without such a program these newer technologies will not be rapidly developed and commercialized.

(2) What Are the Economic Costs and Risks?

The economic costs of energy RD&D, especially at the demonstration stage, are quite expensive. For example, a commercial-scale coal gasification plant (250 million cubic feet per day) would cost on the order of one billion dollars. In addition to the cost of the plant, total costs would include the research needed to determine the environmental and socioeconomic impacts of the facility. Costs of a similar magnitude would apply for coal liquefaction plants producing 50,000 barrels per day (bbl/day), while oil shale plants producing 50,000 bbl/day would cost on the order of $0.6 billion.[1] Commercial-scale geothermal demonstration plants can be much smaller (say 25-50 MWe) and thus less costly. Two demonstration power plants for liquid-dominated resources would cost on the order of one hundred million dollars.

The costs of these facilities would presumably be divided between the public sector (both federal and state governments) and industry. The proportion of costs assumed by each party and the future revenues (if any) would depend on the particular implementation strategy. Public sector front-end costs and economic risk could be minimized by offering certain incentives to industry (e.g., guaranteed prices for production) to construct and operate the demonstration plant. However, the associated impact research must be paid for by the public sector to insure credibility, and the demonstration program must be organized so that there is a viable option of shutting down the demonstration plant or at least preventing further development if the impacts are found to be unacceptable.[1]

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[1] See Chapter 10 on Capital Availability.

Since the results of RD&D projects can never be guaranteed ahead of time, it is not possible to quantify costs versus benefits. However, as mentioned earlier, at the demonstration stage, the technology is usually reasonably well in hand. Due to the large costs involved, commercial-scale demonstrations would not usually be undertaken if there is a high probability of failure. If the RD&D program does lead to large-scale commercial development, the demonstration costs would represent a small proportion of the economic value of all future production.

(3) How Are Costs and Benefits Distributed?

If an RD&D program were successful in developing new technologies for producing western energy resources while minimizing air quality impacts, several sectors or groups would benefit: the nation as a whole would presumably benefit from the increased domestic production of energy; the western states would enjoy the economic benefits that such development would bring while still maintaining a high standard of air quality; and industry would obtain the profits from undertaking the commercial development activities. Thus, to be most equitable the demonstration/commercialization program should be organized so as to share the costs and risks among these sectors.

There has been considerable opposition to federal support of some synthetic fuel demonstration plants. The issue is basically one of equity. On one side, the argument is that these technologies are being utilized at a commercial-scale in other countries; and, therefore, there is no need for government to spend public money to support industry in these endeavors. On the other hand, it is pointed out that the commercial-scale plants in other countries do not operate in the same economic, environmental, and social setting as exists in this country and, therefore, the risks are not the same. The fact is that no large-scale synthetic fuel plants (either coal gasification, coal liquefaction, or oil shale) have been built in the U.S. although the technologies are

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[1] See Kash, Don E., et al. Our Energy Future: The Role of Research, Development, and Demonstration in Reaching a National Concensus on Energy Supply. Norman, Okla.: University of Oklahoma Press, 1976; and Baer, Walter S., Leland L. Johnson, and Edward W. Merrow. Analysis of Federally Funded Demonstration Projects: Final Report, for U.S., Department of Commerce, Experimental Technology Incentive Program. Santa Monica, Calif.: Rand Corporation, 1976, for a discussion of strategies for energy RD&D programs.

"available" in a strict engineering sense. It appears at the present time that some form of public sector support will be required if commercial-scale synthetic fuel plants are to be built. Given the distribution of benefits if this alternative is successful, this seems to be an equitable policy. In any case, it is necessary for credibility reasons for the public sector to fully fund the impact assessments studies that should be performed before a full-scale synthetic fuel industry is developed.

(4) Is the Policy Flexible?

To be most flexible, the demonstration programs should pursue a variety of technologies, subject, of course, to budget constraints, and the best option should then be chosen for large-scale commercialization. Pursuing the fullest set of technologies that funding allows will insure that potentially attractive options are not prematurely dropped. Each project should be fully evaluated along the way using a broad set of criteria including technical and economic feasibility, environmental impacts, socioeconomic impacts, and institutional constraints. Both the planning and evaluation procedures should be open and allow for meaningful public participation, in order to insure that legitimate concerns are addressed in the demonstration program and to help build public confidence in the decisionmaking process.

(5) Does the Alternative Face Implementation Constraints?

This alternative would rank low in terms of ease of implementation. There are several fundamental problems. Perhaps the most important is that it requires large amounts of money from both the public and private sectors. It also requires a considerable amount of cooperation and coordination among industry, the federal government, and western state governments; and depending on the implementation strategy pursued, it could require the creation of a new institutional arrangement among the western states for the joint demonstration program. The history of the COALCON demonstration plant in Illinois points out the kinds of problems that such a program can face.

(6) Summary of Evaluation of Commercialization Alternative

Table 6-24 summarizes the findings for the alternative aimed at bringing new, cleaner energy conversion technologies into commercial use in the West. The option is inherently attractive since it offers the possibility for large levels of energy production and conversion with much lower levels of air pollution than emitted by electric power plants, the predominant energy conversion technology currently being used. However, the policy faces several major hurdles, the most important being the large economic costs involved and the required cooperation among the federal government, western state governments, and industry.

TABLE 6-24: SUMMARY OF EVALUATION OF COMMERCIALIZATION PROGRAM

CRITERIA	MEASURE	FINDING
Effectiveness Achievement of policy objective	Emissions per unit of energy production	All of the new energy conversion technologies considered in this study produce fewer emissions per unit of energy than power plants.
	Level of energy production	If the commercialization program is successful, greater energy production could occur with less impact on air quality than created by power plants.
Efficiency Costs, risks, and benefits	Dollar costs per unit of energy produced	Capital costs for commercial-scale synthetic fuel technologies are high ($0.5-$1.0 billion), while geothermal demonstration is about one-tenth this amount. However, if successful, these costs would be a small fraction of the economic value of all future production.
	Acceptability of risks	There are large economic risks since the demonstration program could lead to a decision not to go to full-scale commercialization.
Equity Distribution of costs, risks, and benefits	Distribution of economic costs and benefits	Depends on specific funding arrangements. If successful, benefits would be shared among industry, federal government, and western state governments; thus, costs and risks should also be shared among these groups.
Flexibility Adaptability to locational needs and changes over time	Level of public participation allowed	Implementation strategy should build in public participation mechanisms.
	Ease of reversibility	Program should be designed so that a decision could be made to preclude full-scale commercialization; this may be difficult to accomplish.
Implementability Adoptability and acceptability	Dollar costs for administration	Implementability is likely to be difficult, especially due to the high dollar costs required for commercial-scale facilities.
	New laws or institutions required	Would require some form of organized cooperation among federal government, western state governments, and industry.

E. Evaluation of Siting Task Force Option

This policy alternative aims at creating an overtly political process for reaching an accommodation between the conflicting interests of energy/economic development and air quality protection. The specific goal of the task force would be to reach a consensus on future sites for major energy conversion facilities, and thus avoid the expensive and time-consuming delays often encountered in energy facilities siting. This approach has been undertaken in Utah, where the governor's office formed a task force composed of representatives from federal land management agencies, state and local governments, environmental groups, consumers, and industry.[1] Although the Utah "Interagency Task Force on Power Plant Siting" was initially formed to resolve siting conflicts with the Intermountain Power Project near Capitol Reef National Park, utilities now have consistently sought the advice of the task force, nominating six to twelve sites for task force evaluation. The result has been an agreement to avoid power plant siting in Utah's scenic and national park-filled southeast quadrant, with eight sites in the central part of Utah identified for future development.

(1) Is the Alternative Effective?

This policy alternative will do nothing directly to reduce air emissions from energy development. What it will do, however, is site power plants in locations where a consensus has been reached that the air emissions will have the fewest adverse impacts.

In terms of levels of energy development, this policy would produce two countervailing forces the net effect of which is difficult to predict. On the one hand, the process could help to eliminate or significantly reduce the debilitating delays that often accompany the siting of large energy facilities. For this reason, it could help to increase energy development. On the other hand, although industry would not be legally bound by the consensus of the task force, they would probably find it difficult to gain permission to site conversion facilities in areas found by the group to be unacceptable. Thus, the conversion of substantial energy resources in some areas could be foregone or delayed. This type of effect has already been noted in the Utah experience, where energy export schemes may be constrained. The head of Utah's Energy Office stated that the Intermountain Power Project, backed by the Los Angeles city utility, may be the last export project in Utah "at least for a long time, since we can't afford to use up any of those other seven sites for outsiders until we're sure we won't need them for Utah's own future power."[2]

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[1] Utah Energy Office, Staff. Personal communication, June 1978.

[2] Gill, Douglas. "Deal Spares Utah Parks Area." Denver Post, May 28, 1978, p. 35.

(2) What Are the Economic Costs?

The administrative cost of the program would be relatively low. Costs would include travel expenses, report preparation, and possible per diem expenses or subsidies for some participants. Costs would increase if research tasks or environmental studies became a major element of task force activities. In the Utah experience many of these costs have been absorbed by participating agencies or groups.[1]

The program could have an effect on energy development costs. By avoiding lengthy delays in the siting process, energy production costs would be reduced. On the other hand, the task force consensus could lead to site choices which are more expensive than would otherwise be chosen by industry including such items as land cost, cooling system costs, coal transportation costs, etc.

(3) Are There Equity Issues?

While some groups may not agree with the final decisions of the task force, the whole concept of this policy alternative is to find an equitable way to reach an accommodation among conflicting interests. If the task force is properly structured so as to permit participation by any potentially impacted group, then the approach should rate high on an equity criterion.

(4) Is the Alternative Flexible and Implementable?

Flexibility of the task force alternative is high, as it is convened at the request of a governor or agency head. Its decisions are an attempt to introduce flexibility into a system that is often characterized by bureaucratic, industrial, and environmental intransigence.

Implementability should also be relatively easy as advisory functions are usually attractive to most participants and costs are low. However, because the effectiveness of the task force requires a specific response on the part of industry, some resistance to implementation could occur. In the case of Utah though, industry has been a very willing participant.[2]

(5) Summary of Evaluation of Siting Task Force Alternative

The conclusions for the evaluation of the siting task force alternative are summarized in Table 6-25. This policy option and the findings are based largely on the experience with the Utah "Interagency Task Force on Power Plant Siting." If the task force

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[1] Utah Energy Office, Staff. Personal communication, June 1978.

[2] Utah Energy Office, Staff. Personal communication, June 1978.

TABLE 6-25: SUMMARY OF EVALUATION OF SITING TASK FORCE ALTERNATIVE

CRITERIA	MEASURE	FINDING
Effectiveness Achievement of policy objective	Emission per unit of energy production	No direct effect.
	Effect on lead times for constructing facilities	By identifying and reaching an agreement among interested parties on future sites for energy facilities, it is expected that siting delays could be reduced.
	Level of energy production	Could restrict development by limiting number of sites available.
	Extent of environmental impacts	Although emission levels won't necessarily be reduced, areas would be identified where the environmental impacts are less serious.
Efficiency Costs, risks, and benefits	Dollar costs per unit of energy produced	Costs of task force should be small; would be higher if task force undertook extensive environmental studies. Energy production costs for the sites agreed upon could be higher than for sites industry might select on their own. On the other hand, costs could be lower by reducing siting delays.
	Acceptability of risks	Industry could object to the risk of higher production costs for the consensus sites. In Utah experience, this has not been the case.
Equity Distribution of costs, risks, and benefits	Distribution of economic costs and benefits	Fundamental purpose of task force is to provide an equitable means for reaching facility siting decisions, considering the oftentimes conflicting values of affected parties.
Flexibility Adaptability to locational needs and changes over time	Level of public participation allowed	Highly flexible. Convened at request of governor or other official. All interested parties allowed to participate.
Implementability Adoptability and acceptability	Dollar costs of administration	Dollar costs are low.
	New laws or institutions required	Ad hoc nature; no new laws or institutions required.
	Groups likely to be in favor or opposed	Since effectiveness depends upon a specific response on part of industry to task force consensus, industry opposition could exist.

is successful in reaching a consensus on future sites, siting delays and air pollution impacts would be reduced. This approach is attractive since administrative costs are low and flexibility is high; the goal is to avoid the bureaucratic and legalistic conflicts that often surround energy facility siting decisions. However, success of the approach will depend on a spirit of cooperation and an ability to reach a consensus where there are often fundamental value differences among interested parties. The limited experience in Utah indicates that such an agreement is possible, but this may not be the case in other states. Also, energy development could be constrained due to a limited number of sites agreed upon.

F. Summary and Comparison of Air Quality Policy Alternatives

Three categories of alternatives and nine specific alternatives for protecting western air quality while proceeding with western energy resource development have been identified and described. Four of the specific alternatives were evaluated using five criteria: effectiveness, efficiency, equity, flexibility, and implementability. Table 6-26 provides a brief summary and comparison of these four alternatives. While the net effect of any one alternative is uncertain, each has the potential for contributing to the achievement of the policy objective but in different ways and with different levels of efficiency, equity, etc. The BACT definition of 90 percent sulfur removal is a regulatory program aimed at limiting SO_2 emissions for large coal burning facilities, especially power plants. This standard is not expected to have a major effect on the number of power plants constructed in the western region but it will dampen the demand for raw western coal. A complimentary approach is offered by the commercialization program alternative, the goal of which is to bring into practical use new energy conversion technologies which are inherently less polluting than conventional coal-fired power plants. This could allow larger levels of western energy development while still protecting air quality. Unlike these previous two policies the smaller dispersed facilities alternative and the siting task force alternative do nothing directly to reduce emission rates. Rather, the smaller, dispersed facilities approach attempts to minimize adverse air impacts by reducing the peak air pollution concentration levels that would otherwise occur. Its effect on overall energy development levels is uncertain. The siting task force option primarily aims at eliminating some of the procedural problems which constrain western energy development; it contributes to the protection of air quality by identifying those areas where it is agreed the air emissions would have the fewest adverse consequences.

The other four criteria (efficiency, equity, flexibility, and implementability) reflect other pros and cons of the policies which can be measured against their effectiveness. Since, as just described, the goals of each policy vary widely and the net effects are uncertain, it is difficult to make direct comparisons among the alternatives. Nevertheless, in the preceeding evaluations certain important conclusions stand out. The BACT option could be easily implemented under the provisions of the 1977 CAA and it would achieve certain equity goals. However, it is not very flexible since locational variables are not taken into account and it is not very efficient because there are no incentives for using low sulfur coals. In some instances, lower or equal SO_2 emission rates could be achieved by requiring a smaller sulfur removal percentage in conjunction with the use of a lower sulfur coal. This would also lessen the sludge disposal, water consumption, and energy efficiency problems associated with currently available FGD processes.

While the smaller, dispersed facilities option offers some potentially attractive features, as indicated in Table 6-26 the pros and cons can vary greatly on a case-by-case basis. Given the uncertainty, an attractive implementation strategy would be for utility commissions and federal agencies to require industry to consider this approach in its planning activities. This would give recognition to the idea and generate better information on its possible benefits, but it would not force an across-the-board adoption of the alternative.

Over the long term, the commercialization program offers the greatest possible benefits of the four specific alternatives considered. However, there are a number of major obstacles to this approach. Economic costs for demonstration plants are high. Even though these costs would be small relative to the value of future energy production, the possibility of a negative decision on a large-scale commercialization resulting from the demonstration makes the economic risks substantial. These high initial costs combined with the need for cooperation and cost sharing among the federal government, western state governments, and industry make implementation difficult.

The siting task force alternative represents an attractive option for policymakers. Economic costs for task force operation are low, flexibility is high, and the alternative should be relatively easy to implement. Thus, although the effectiveness is uncertain, it does offer potential benefits with very little cost or risk.

In conclusion, the systematic evaluation procedure followed not only helps identify the particular strengths, weaknesses, and uncertainties for each specific alternative but in some cases it also suggests appropriate implementation strategies and/or modifications to the policies which might correct some of the major deficiencies. For example, with regard to the BACT alternative, some of the negative aspects could be eliminated by an approach which sets percentage sulfur removal requirements as a function

TABLE 6-26: SUMMARY AND COMPARISON OF AIR QUALITY POLICY ALTERNATIVES

CRITERIA	BACT DEFINITION	SMALLER, DISPERSED FACILITIES	COMMERCIALIZATION PROGRAMS	SITING TASK FORCE
Effectiveness Achievement of policy objective	Air emissions per unit of electricity would be reduced. Also, it causes a drop in exports of Northern Great Plains coal relative to case of continuation of current NSPS.	No direct effect on emission rates. Eases siting difficulties for individual plants by reducing lead times and concentration of adverse impacts. However, increases the number of plants to be sited and this could slow development.	Reduces emissions per unit of energy produced by encouraging development of energy resources and conversion technologies with fewer air emissions than power plants.	No direct effect on emission rates, but sites would be selected to minimize adverse impacts. Energy development would be encouraged by making siting easier, but level of energy development could possibly be constrained because of limited number of sites agreed upon.
Efficiency Costs, risks, and benefits	Electricity prices would be increased by 3.5 percent for West. It is inefficient since no incentives are given for utilizing low sulfur coals. There are also adverse side effects: large amounts of sludge waste, increased water consumption, and lower energy efficiency.	The net effect is uncertain. Capital and operating costs would be increased. Land used for power plants would be increased. Land use for energy transportation would depend on site-specific factors. Boomtown impacts would be reduced.	Capital costs would be high, but if large-scale commercialization occurs it would represent only a small fraction of the economic value of all future production.	The economic costs of task force operation are small; costs would be higher if research and environmental studies are undertaken. Energy production costs could be reduced by lower siting costs, but they might be increased due to higher production costs for the sites chosen.
Equity Distribution of costs, risks, and benefits	Would achieve the national objective of putting western coals on more equal economic costs footing with other coals. Electricity price increases would be highest for the western region. Emission rates among states would be equalized.	Air pollution and tax and other economic benefits would be distributed more evenly across the region.	Costs and benefits would be shared among the nation, western region, and industry.	Would provide a procedural mechanism for reaching an equitable decision, balancing widely differing viewpoints and values.

TABLE 6-26: (Continued)

CRITERIA	BACT DEFINITION	SMALLER, DISPERSED FACILITIES	COMMERCIALIZATION PROGRAMS	SITING TASK FORCE
Flexibility Adaptability to locational needs and changes over time	Not very flexible. Locational variables and state and local controls are not taken into account.	Flexibility depends on specific implementation strategy. It would not be advisable to force this approach; rather it could be encouraged by state utility commissions and federal agencies in industry planning requirements.	Planning and evaluation should include public participation. The option to preclude full-scale commercialization could be retained.	Highly flexible; it will be ad hoc in nature and public participation is the key feature.
Implementability Adoptability and acceptability	The standard could be set under 1977 Clean Air Act Amendments. It would create practical dificulties in monitoring for EPA.	Encouragement by state utility commissions and/or federal agencies should be straightforward. Industry would be likely to strongly oppose any mandatory requirements for smaller, dispersed facilities.	Difficult to implement. Dollar costs are high and there would be a requirement for cooperation among federal governments, western states, and industry.	Dollar costs for administration would be low and no new institutions or laws would be required. It would require a spirit of cooperation to be successful.

BACT = best available control technology

NSPS = new source performance standards

EPA = Environmental Protection Agency

of the sulfur content of the coal. Finally, it should be noted that the four specific alternatives chosen for evaluation are not mutually exclusive. These four (and others) could be implemented simultaneously, with each making a different contribution to the resolution of the problems and issues surrounding western energy development and air quality.

CHAPTER 7

LAND USE AND RECLAMATION

EXECUTIVE SUMMARY

Energy resource development can lead to three kinds of land-use and reclamation problems and issues in the West. First, energy development will often produce or intensify conflicts between energy developers and farmers, ranchers, environmentalists, recreationists and other land users. Second, although only a small percentage of lands will be affected region-wide, the percentage of land affected in some locations within the region can be extensive. Third, it is not clear that lands disturbed by energy resource development can be successfully reclaimed in all parts of the region. Dealing with these land-use and reclamation issues will challenge the planning, monitoring, and enforcement capabilities of all levels of government.

Impacts

Energy development will disturb lands used for mines, access roads, support and conversion facilities, waste disposal, and population uses for housing and recreation. Results of our analysis of land-use and reclamation impacts suggest that:

- Direct land use by coal surface mines can be about 10 times greater than for underground mines and coal conversion facilities (Figure 7ES-1).
- Compared on a thermal energy equivalent basis, oil shale retorts require at least twice as much land as any other conversion facility. About 70 percent of the land required for an oil shale retort is for spent shale disposal. Compared on a typical facility size basis, electric power generation requires more land than any other conversion facility.
- Siting choices affect land requirements for coal mining because of the heating value (British thermal unit content) of the resource and its seam thickness. For example, the number of acres disturbed at Beulah, North Dakota, and at Farmington,

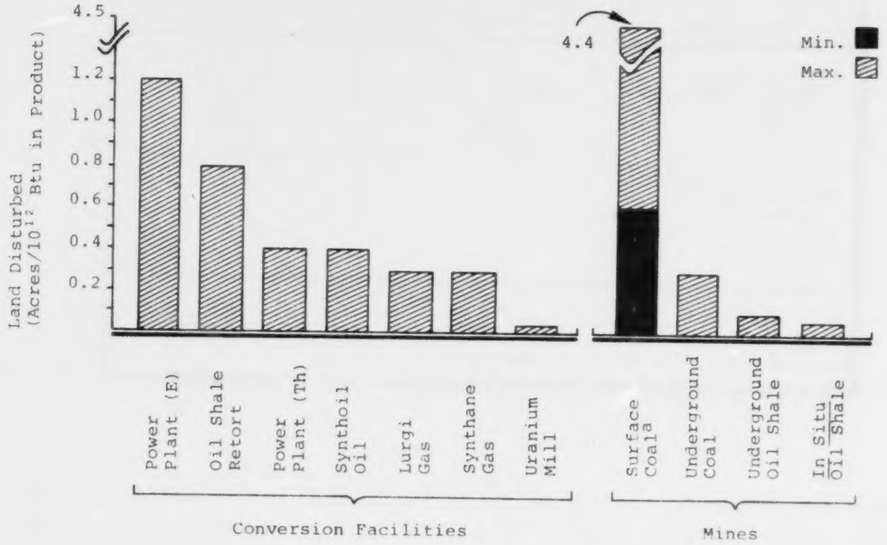

Figure 7ES-1: Land Use by Technology

[a] The range of values is the range found in the four sites utilizing surface coal mining and calculated based on 12 MMtpy production rates. Ranges are attributable to variations in coal seam thicknesses and heating value.

New Mexico, could be more than twice that disturbed at Gillette, Wyoming, or Colstrip, Montana, for the same size power plant (Table 7ES-1).

- Land use to meet the needs of energy-related population growth generally produces more significant ecological impacts than land used directly by the energy facilities. Public lands (national parks, forests, recreation, and wilderness areas), particularly those in a natural state, are likely to experience the greatest changes, primarily as a result of increased use due to population growth.

TABLE 7ES-1: LAND USE FOR MINES FOR SIX SPECIFIC LOCATIONS[a]

TYPE/SITE	TYPICAL SIZE MINE (acres over 30 years)	EQUIVALENT ENERGY (acres per 10 Btu)
Surface Coal		
Navajo/Farmington	4,000 - 27,820	.5 - 3.2
Gillette	4,030	0.5
Colstrip	9,680	1.2
Beulah	24,210	3.0
Underground Coal		
Kaiparowits	1,700	0.2
Underground Oil Shale		
Rifle	4,200	0.5

Btu = British thermal unit

[a] Average includes all surface lands disturbed, including disposal of wastes such as spent oil shale.

- By the year 2000, large-scale land use associated with energy development could disturb and fragment wildlife habitat to the point of eliminating some local mammal and bird populations.
- The long-term potential for reclaiming mined lands, depends on important locational features, including climate (especially annual rainfall and its seasonal distribution), soil composition, topography of the land, and existing biological communities. For example, the arid climate and poor topsoil characteristics of the Southwest region provide for an ecosystem that is more difficult to restore than in the Northern Great Plains.
- On a region-wide basis, population increases are expected to double or triple recreation demands in the areas of the Upper Colorado and Missouri River Basins. These demands will stress surrounding natural resources, especially national parks and wilderness areas.

The Policy Context

In the western states, competing values and interests with regard to land use and energy development have already produced conflicts. Expanded energy development will heighten existing conflicts and also result in new problems and issues. Social and political considerations relevant to land use and reclamation conflicts include:

- Demands for land by energy developers come at a time when the public interest in land use is being redefined, both in terms of broad environmental goals and the policies and institutions which control land use. For example, the proposition that land, like air and water, is a basic national resource in which the public has a broad interest is gradually being accepted and codified.

- Public awareness of the direct and indirect adverse effects of mineral extraction and utilization on environmental quality is growing.

- Reclaiming disturbed lands remains a critical policy problem even though new coal surface mine regulations have been developed as a result of the 1977 Surface Mining Control and Reclamation Act.

- Comprehensive reclamation objectives and requirements have not been formulated for oil shale and uranium.

- To the extent that it exists in the West, land-use planning is characteristically fragmented among levels of government and among agencies within each jurisdiction. Land use and administrative priorities practices vary greatly between private lands and public lands administered by the Bureau of Land Management, National Forest Service, Park Service, and Bureau of Sport Fisheries and Wildlife.

The potential impacts of energy resource development on land-use requirements and the nature of the existing policy system suggest why land-use and reclamation issues have become so important. More specifically, the following conflicts over land-use and reclamation problems could increase:

- Most of the energy resources developed in the West will be extracted by surface mining which not only disrupts large land areas, but also produces more visible land impacts than underground mining. Relatively little is known about the long-term success of land reclamation in the West, raising questions about the adequacy of existing policies and institutional arrangements for returning mined lands to their preexisting or some other productive use.

- As shown in Figure 7ES-2, energy development must compete with other economically productive land uses such as grazing and row crops; and it must compete with preservation and conservation and leisure-time and recreational uses. Large-scale energy resource development

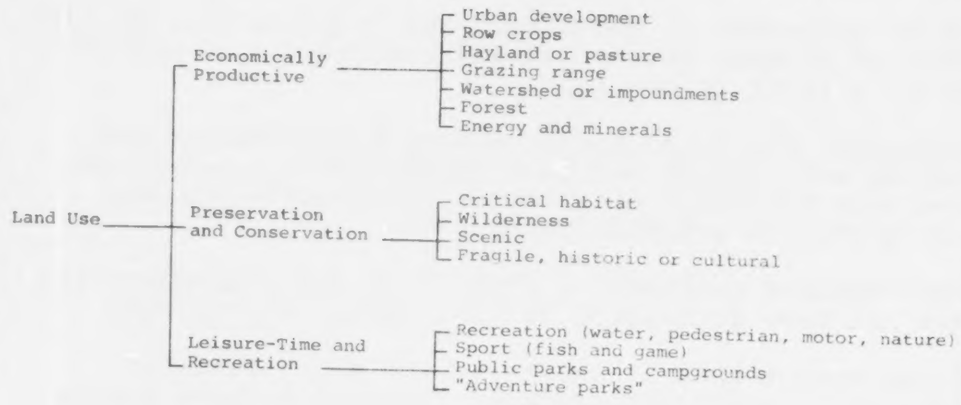
Land Use
Economically Productive
Urban development
Row crops
Hayland or pasture
Grazing range
Watershed or impoundments
Forest
Energy and minerals
Preservation and Conservation
Critical habitat
Wilderness
Scenic
Fragile, historic or cultural
Leisure-Time and Recreation
Recreation (water, pedestrian, motor, nature)
Sport (fish and game)
Public parks and campgrounds
"Adventure parks"

Figure 7ES-2: Elements of Land Use Demand

and the associated large population increase that can be expected will intensify this competition during the next two decades or so, taxing the capabilities of all levels of government.

- Activities associated with mining and conversion create an influx of people. Long valued for scenic beauty, the recreational areas of the region would undergo significant transformation if a high percentage of energy resources were developed rapidly and large numbers of people moved into the region. Conflicts emerge among a variety of constituents and among government agencies as to how this increased use should be accommodated or controlled (see box "New Recreation Demands").

Alternative Policies

Two general policy objectives for dealing with land-use and reclamation issues associated with western energy resource development have been identified:

- Insure that the institutions and processes for making land-use and reclamation policies give adequate consideration to a range of interests;

- Provide for and protect a diversity of present and future land-use patterns.

These two objectives could incorporate a broad range of policy alternatives. Thus this policy analysis has been narrowed to focus on an objective more specifically related to western energy resource development:

- To meet the land-use needs of energy development, including the land requirements of energy-related population increases, while providing for and protecting a diversity of present and future land uses.

NEW RECREATION DEMANDS

Grand Teton National Park is located 100 miles north of energy boom town Rock Springs, Wyoming. Residents combined with out-of-state tourists resulted in 3 million visitors to the park in 1976. "Wyoming is feeling the effects of energy development," says Senator John Turner. "It's doubled the population in some communities, brought in a rough crowd, caused in increase in mental health problems, divorce, alcoholism, and crime." Due to these increases 70 percent of the respondents in a public opinion survey of residents of Jackson Hole (in the park) favored strong land-use controls and very limited growth.

--Leydet, Francois. "Jackson Hole: Good-Bye to the Old Days." National Geographic, Vol. 150 (December 1976), p. 771.

As shown in Table 7ES-2, establishing a better coordinated, comprehensive land-use planning and management system to control land use is one way to try to achieve this objective. Specific alternatives include designating permissible land uses, controlling access to public and private lands, requiring reclamation, and requiring redevelopment. These alternatives are not mutually exclusive and a comprehensive land-use planning and management system would probably include both control and rehabilitation choices.[1] Each alternative could be designed to achieve the objective of supporting energy development while providing for and protecting a diversity of present and future uses. The two categories of alternatives differ primarily in emphasis.

The first category of alternatives emphasizes a comprehensive planning approach which attempts to insure the most appropriate or least damaging combination of technologies and locations (see Chapter 12 on Energy Facility Siting). Based on an understanding of

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[1] Terminology in this problem area is not standardized. As used here, rehabilitation means that disturbed lands will be restored to some productive use; reclamation means restoring to the predevelopment use; redevelopment means restoring to some other productive use.

TABLE 7ES-2: POLICY ALTERNATIVES FOR LAND-USE AND RECLAMATION

POLICY OBJECTIVE	CATEGORY OF ALTERNATIVE	SPECIFIC ALTERNATIVE
Meet the land-use needs of energy resource development, including those associated with population increases, while providing for and protecting a diversity of present and future land uses	Control land use and changes in land use	Designate permissible land uses Control access to and activities on all public and private lands
	Require rehabilitation of all lands disturbed by energy resource development	Require reclamation (return to predevelopment use) Require redevelopment (return to some other productive use)

present and future land needs and the compatability of specific land areas and land uses, permissible land uses for these land areas are identified. This means, of course, that certain land uses may be explicitly prohibited, for example, surface mining on prime agricultural lands. And it may be considered desirable to control access to and activities in designated permissible use areas. For example, the number of people allowed in a recreation area at any one time may be limited; and snowmobiles may be permitted but not other kinds of off-road vehicles.

The second category of alternatives emphasizes returning lands disturbed by energy resource development to a productive use. Within the existing land-use and management system, lands would be made available to meet energy needs with the stipulation that they be rehabilitated. Specific alternatives would be to require either reclamation or redevelopment (e.g., public parks and services). Reclamation could be implemented by continuing existing requirements or making the system more flexible. The redevelopment alternative would require changes in the regulatory structure, such as requiring approval of a redevelopment plan. As with the first category of alternatives, this approach could give the lead planning and management role to the federal government, to the states, or to a multistate organization.

Findings

Two specific alternatives for dealing with land-use issues related to western energy research development are considered in this report: reclamation and revegetation. Findings of our evaluation and comparison of these two alternatives include:

- Redevelopment of surface mined land appears more likely to succeed than does reclamation, primarily because of the uncertainty of reclamation success in arid and semiarid areas. In general, redevelopment can put lands back to productive uses three to four years earlier than reclamation, is much more adjustable to site-specific conditions, and allows local officials much more discretion in interpreting local needs.
- Economic costs for reclamation and redevelopment appear to be about the same. Reclamation is estimated to cost about $1,000 to $7,000 per acre; redevelopment will cost about $1,000 to $6,000 per acre.
- Environmental costs appear substantially higher for redevelopment than for reclamation, since reclamation is more aesthetically beneficial and preserves a broader range of future land uses. However, more environmental risks are associated with reclamation since its potential success in many areas is uncertain.

Conclusion

One obvious conclusion which can be drawn from these findings is that several trade-offs can be made by choosing one alternative, over another. For example, if getting lands back into production as soon as possible is the value which ranks highest for policymakers, redevelopment is the better choice; but if maximizing potential environmental benefits is most highly valued, reclamation is the more appropriate choice.

It is also clear that this analysis is incomplete. This is largely because of the lack of adequate information but also because it was not possible in this study to evaluate all potential policy alternatives. What is reported can be interpreted to imply that policymakers are faced with an either-or choice, either reclaim to predevelopment use or redevelop for a recreational use. Obviously, the choices are not this constrained. In fact, neither reclamation nor redevelopment emerges as the "best" choice; reclamation because there are areas where it will probably be impractical if not impossible and and redevelopment because there are limits as to how much and where there is an additional recreational need and because it may also require some of the same things as reclamation, for example, revegetation. But the point that the results of this analysis leads to, despite its limitations, is that it is not at all obvious that the current policy of most states and the federal government is as well-informed as it might be. Given the high level of uncertainty about being able to reclaim arid and semiarid lands successfully, present policies seem to be an oversimplified response to a complex problem. A blanket policy of returning disturbed lands to their predevelopment uses largely ignores the possibility of land-use changes in the surrounding area due both to energy and other developments. In particular, the established need for expanded recreational opportunities for energy-related population increases challenges the appropriateness of a policy which emphasizes only reclamation. Further, current policy can require large per acre reclamation expenditures that may be ineffective regardless of how vigorous the reclamation attempt is, and will almost certainly require the use of scarce water resources for activities of uncertain environmental or economic value. A more balanced policy would provide for determining local needs and basing the choice between reclamation and redevelopment (and the specific redevelopment use) on what the needs are determined to be.

Clearly there is a need for more knowledge in this problem area and a need to review land use and reclamation policies on a continuing basis. The experience gained from current developments will help to provide the knowledge base needed for this review as will the numerous research efforts currently under way.

Finally, current laws and regulations ignore surface mining for other energy resources such as oil shale and uranium. Given the quantity of those resources in the West, this omission cannot continue unless we are prepared to have these lands withdrawn from productive uses for an extended time period.

CHAPTER 7

LAND USE AND RECLAMATION

7.1 INTRODUCTION

Energy resource development can lead to three kinds of serious land-use and reclamation problems and issues in the West. First, energy development will often produce or intensify conflicts between energy developers and other land users such as farmers, ranchers, environmentalists, and recreationists; second, although only a small percentage of lands will be affected regionwide, the percentage of land affected in some areas within the region can be quite large; and third, it is not clear that lands disturbed by energy resource development can be successfully reclaimed in all parts of the region. Dealing with these land use and reclamation issues will challenge the planning, monitoring, and enforcement capabilities of all levels of government.

Energy development will disturb land in a variety of ways, including the lands used for mines, access roads, support and conversion facilities, waste disposal, and recreation. Demand for land for energy development comes at a time when the public interest in land use is being substantially redefined, both in terms of broad environmental goals and the policies and institutions which control land use. Increasingly, the proposition that land, like air and water, is a basic national resource in which the public has a substantial interest is being accepted and codified.[1]

Historically, land use was discussed almost exclusively in terms of the interests of the developer or land user. A major reason that this has changed is a growing public awareness of the direct and indirect adverse effects of minerals extraction and utilization on environmental quality.

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[1] For elaboration of this point, see Clawson, Marion, and Burnell Head. The Federal Lands. Baltimore, Md.: published for Resources for the Future by Johns Hopkins University Press, 1957; Bosselman, Fred and David Callies. The Quiet Revolution in Land Use Control. Washington, D.C.: Government Printing Office, 1972; and Healy, Robert G. Land Use and the States. Baltimore, Md.: published for Resources for the Future by Johns Hopkins University Press, 1976.

Recently passed national coal strip mine legislation underscores the current emphasis on regulating the use of public and private lands in the interest of both mine operators and the general public. In fact, land use as an issue category highlights conflicts among energy and environmental values.

In the western states, competing values and interests with regard to land use and energy development have already produced significant conflicts. Findings reported in our Energy From the West impact analysis reports[1] suggest that projected energy development in the West is not only likely to exacerbate existing conflicts but to result in new problems and issues as well.

These problems and issues are expected to be a consequence of several closely related technological and social considerations discussed below. First, as noted in Chapter 2, a majority of the minerals in the western states are owned or administered by agencies of the federal government or Indian tribes. A unilateral decision by the federal government or an Indian tribe to develop these resources will intensify tensions already existing among the states, Indian tribes, and the federal government.

Second, many of the energy resources developed in the West will be extracted by surface mining techniques which not only disrupt large land areas, but also produce much more visible land impacts than does underground mining. Moreover, energy resources are frequently located in forest, range, or farm areas. Development in these areas raises questions about appropriate land uses and the long-term potential of postmining reclamation.

Third, regardless of the mining or conversion technology used, energy development means an influx of people. Long valued for its scenic beauty and pristine air quality, the region would undergo significant transformation if a high percentage of its energy resources were developed rapidly and large numbers of people moved into the region.

As noted in Chapter 2, westerners' attitudes toward energy resource development are mixed. While many view it in essentially negative terms, many others consider it desirable. To those who hold the latter view, development means more jobs, an expanded economic and tax base, more and better public services, and a chance for new social and cultural experiences. This is especially the case in areas which stand to benefit economically from growth. In this light, land for energy development is given up or traded for a variety of benefits. The extent to which social, economic, and environmental costs and benefits can be equitably distributed is an important policy consideration, especially when public lands are involved. It is because this range of interests and values is at stake, and competing claims to the benefits of finite land resources have to be accommodated that land use and reclamation is a significant category of policy problems and issues in western energy resource development.

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[1] See White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

In the following section, these land-use problems and issues are discussed beginning with a summary of land-use and reclamation impacts. The social and political context within which these impacts will occur is then described, and the problems and issues likely to arise when these impacts occur within this context are identified and defined. Alternative policies and implementation strategies for dealing with these problems and issues are then identified, evaluated, and compared.

7.2 LAND-USE AND RECLAMATION PROBLEMS AND ISSUES

7.2.1 The Land-Use Impacts of Energy Resource Development

As described in our Energy From the West progress report, the extent and type of land-use impacts can vary depending on the choice of energy technology and location.[1] Technological factors which can significantly affect impacts include the method of mineral extraction, the type of conversion facility, and the labor requirements of the technology. Critical locational factors include overburden characteristics, coal seam thickness, heat content of the resource, climatic and soil characteristics, the nature of the terrain, and existing biological communities in an area.

A. Variations in Land Use by Technology

Variations in land use by technology are shown in Table 7-1 for the size facilities deployed in our scenarios and on an equivalent energy basis. Compared on an equivalent energy basis, land requirements for conversion facilities do not differ significantly, and land requirements for an underground coal mine are similar to that for conversion facilities. However, land disturbed by surface

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[1] See White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

TABLE 7-1: LAND USE BY TECHNOLOGY

FACILITY	TYPICAL SIZE (acres per 30-year life of facility)	EQUIVALENT ENERGY (acres per 10^{12} Btu in product)	PRODUCT
Conversion Facilities[a]			
Power Plant (3,000 MWe)	2,400	1.2	Electricity
		0.4	Thermal
Lurgi Gas (250 MMcfd)	805	0.3	Gas
Synthane Gas (250 MMcfd)	805	0.3	Gas
Synthoil Oil (100,000 bbl/day)	2,060	0.4	Oil
Oil Shale Retort (50,000 bbl/day)[b]	2,150	0.8	Oil
Uranium Mill (1,000 tpd)	280	0.03	Yellowcake
Mines			
Underground Oil Shale (26 MMtpy)	500	0.1	Oil Shale
In Situ Oil Shale (57,000 bbl/day)[c]	180	0.06	Oil
Underground Coal[d] (12 MMtpy)	1,760	0.3	Coal
Surface Coal[e] (12 MMtpy)	3,300-25,200	0.6-4.4	Coal
Surface Uranium[f] (1,100 tpd)	3,450	NC	Uranium ore
Underground Uranium (1,100 tpd)	70	0.01	Uranium ore
In Situ Uranium (1,000 tpd)	U	NC	Uranium ore

Btu = British thermal units
MWe = megawatts-electric
MMcfd = million cubic feet per day
bbl/day = barrels per day

tpd = tons per day
MMtpy = million tons per year
NC = not considered
U = unknown

[a] Land required for above-ground energy conversion facilities. This number remains unchanged through the lifetime of the facility.

[b] Includes 650 acres for the retort site and 1,500 acres for spent shale disposal over 30 years.

[c] Includes land for surface structure associated with the mine (100 acres) and in situ process (80 acres).

[d] Includes only that portion of the mine site to be permanently occupied. At Kaiparowits, 30,000 acres will be subject to subsidence over the 30-year life of the mine. It is expected that nearly all of this land will be reclaimed and and returned to productive use.

[e] The range of values is the range found in the four sites utilizing surface coal mining and calculated based on 12 MMtpy production rates. Ranges are attributable to variations in coal seam thicknesses and heating value.

[f] Assumes annual acreage requirement of 115 acres per year and ore waste disposal in mined-out areas.

coal mine can be ten times greater than for conversion facilities or underground mining depending on the seam thickness and the heating value of the coal (see the discussion below of locational characteristics).

Depending on the level of development, between 1,000 and 1,500 square miles of land could be disturbed in the eight-state study area by the year 2000 by coal mining alone. As shown in Table 7-2, the magnitude of this surface land disturbance is projected to be larger for the Northern Great Plains than for any other area. At some locations up to 18 percent of entire counties could be disrupted. Although impacts assessed for the eight states indicate that coal mining will disturb the largest amount of land regionally, uranium, oil shale, oil and gas, and geothermal development will also produce local land disruption.

Direct land use produces a range of impacts. The magnitude of land disruption can be visually shocking. Protective vegetation is destroyed and soil and rock overlying the coal (or other mineral deposit) are scraped away, resulting in a massive, visible alteration of the surface. Such activities can also lead to water pollution problems, disrupt normal surface and groundwater flows,[1] cause soil erosion and related ecological impacts, and, ultimately, restrict future land uses.

Ecological impacts may show up in reductions in the overall carrying capacity of an area (see box). Generally, ecological impacts will be local, although if many facilities are sited in an area, direct land use can eliminate or reduce a large percentage of habitat types and result in significant areawide reductions in carrying capacity. Also, impacts from erosion and water pollutants, as well as air pollutants, from both mines and power plants can cause widespread ecological effects.

ECOLOGICAL IMPACTS IN RIFLE, COLORADO

Developmemt of one oil shale retorting facility in the vicinity of Rifle, Colorado disturbs less than one percent of the land area in Garfield and Rio Blanco Counties. However, ecological impacts can increase rapidly with expanded development; for example, carrying capacity of deer can decrease dramatically as an area is developed.

--White, Irvin L., *et al*. *Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development*. Washington, D.C.: U.S., Environmental Protection Agency, 1977, p. 91.

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[1] For elaboration, see Chapters 4 and 5 on water availability and quality.

TABLE 7-2: ACREAGE DISTURBED BY COAL SURFACE MINING

AREA	LOW DEMAND CASE[a] (thousands of acres)
Northern Great Plains	
North Dakota Lignite[b]	447
Powder River[c]	396
Intermountain Area[d]	39
Four Corners Area[e]	69

Source: White, Irvin L., *et al*. *Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development*. Washington, D.C.: U.S., Environmental Protection Agency, 1977, p. 877.

[a] Based on energy demand for coal projected by Low Demand level of development (124 quadrillion British thermal units supply) by the year 2000.

[b] Includes Billings, Bowman, Dunn, Hettinger, McKenzie, McLean, Mercer, Oliver, Slope, Stark, and Williams Counties, North Dakota. Assumed average seam thickness of 12.5 feet.

[c] Includes Powder River, Bighorn, and Rosebud Counties, Montana, assumed average seam thickness 27 feet; and Campbell, Johnson, and Sheridan Counties, Wyoming. Assumed average seam thickness is 64 feet.

[d] Includes Rio Blanco, Garfield, and Huerfano Counties, Colorado, assuming one-third of the projected mines are underground, and an average seam thickness of seven feet.

[e] Includes San Juan County, New Mexico, with an assumed average seam thickness of 10.3 feet; and Kane and Garfield Counties, Utah, assuming half the projected mines are underground, and an average seam thickness of 10 feet.

Underground coal, oil shale, and uranium mining poses surface problems in preventing and controlling land subsidence (see box). Changes range from surface impacts (uneven ground and/or cracks) to drastic alterations (gaping holes). Like strip mining, underground mining also can: lead to water pollution problems, intercept groundwater aquifers, require mine dewatering, deplete aquifers and, ultimately, change land uses.

SINKING HOMES IN ROCK SPRINGS

Subsidence has recently become a serious problem in Rock Springs, Wyoming. The town sits on a network of mine tunnels created over the last 100 years or so. Just within the last several years, it has become necessary to condemn and destroy several houses which sank into the ground as much as four feet.

--Strabala, Bill. "Age Transforms Subsurface Mines' Beauty Into Beast." Denver Post, March 13, 1977, p. 20.

Other land-use problems concern waste disposal (e.g., coal ash and toxic mine wastes), such as the stabilization of evaporative holding ponds for energy conversion facilities, mine settling ponds, and tailing ponds for uranium mills. These ponds continue to require maintenance, especially after sites and facilities are abandoned.[1] In the past, erosion has contributed to atmospheric and water pollution, and uranium tailings have contributed to public exposure to radiation.

Finally, a network of unpaved service and maintenance roads contributes to area-wide water and air pollution and fragments wildlife habitats. Wells in oil and gas fields are linked by a web of eroding roads that reduce aesthetic and biological values. Procedures to stabilize these various kinds of roads may not be adequate and new roads may have to be added when washouts occur.[2]

B. Energy-Related Population Increases

Variations in the labor intensity of technologies can be another important land-use factor. That is, some technologies require a larger work force to produce the same quantity of energy than do others. This is significant for land use primarily in terms of the overall population increases resulting from different levels of energy development.[1] As illustrated in Table 7-3, operation-related or permanent population increases alone for the Low Demand Case (124 quadrillion British thermal units (Btu) supply) would result in 157,200 new people coming to the region by 1990 and 456,600 by 2000.[2] Most of these regional population increases are projected to occur in rural locations. In some instances these increases will occur in areas used extensively for recreation in both summer and winter, such as in the mountains of Colorado and Wyoming. Population increases are also projected for areas where much of the land is used for grazing or agricultural crops, such as in the Northern Great Plains.

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[1] See White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, pp. 55-57; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S. Environmental Protection Agency, forthcoming.

[2] U.S. Geological Survey, staff. Personal communication, Reston, Va., 1977.

TABLE 7-3: PERMANENT POPULATION INCREASES AFTER 1975 DUE TO ENERGY DEVELOPMENT IN EIGHT-STATE REGION

YEAR	LOW DEMAND CASE[a]
1980	45,000
1985	118,200
1990	157,200
2000	456,600

Source: The 1975 estimated population for the eight states was 9,551,000. See U.S., Department of Commerce, Bureau of Census. "Estimates of the Population of States, By Age: July 1, 1974 and 1975 Advanced Reports." Current Population Reports, Series P-25, No. 619, January 1976.

[a] Based on energy demand for coal projected by Low Demand level of development (124 quadrillion British thermal units supply). See White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Chapter 12.

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[1] For a more detailed breakdown of populations and levels of development, see White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Chapter 12; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming, Chapter 11.

[2] The large increase during the 1990's would primarily be due to the large-scale development in Colorado and extensive coal production in the Northern Great Plains. For a discussion of the Low Demand Case energy forecast, see White et al. Energy From the West: Progress Report; and White et al. Energy From the West: Impact Analysis Report, Chapter 11.

Ecological stresses brought on by energy development are closely related to the size of human populations in the study area. Anticipated population growth will occur disproportionately near areas with high value for backcountry recreation. Estimates made for the Missouri River Basin Comprehensive Framework Study[1] indicate that it is reasonable to expect recreation demand to double or triple by the year 2000. Since the early 1970's, backcountry recreational activities such as hiking, snowmobiling,[2] jeeping, and backpacking or packing with horses have been rising in popularity, accounting for 5-15 percent of the total use in areas such as national forests. These activities are particularly popular in the West.

Although the intensity of use is uncertain, the locations of recreation activities generally fall into three categories: major established tourist attractions (e.g., Yellowstone and Grand Teton National Parks); areas near population centers (e.g., Grand Mesa National Forest, near Grand Junction); isolated areas or areas with limited recreation opportunities (e.g., Black Hills National Forest in Wyoming and South Dakota). Figure 7-1 shows some major areas likely to be used more intensively because of region-wide energy development. If access to these areas is limited or controlled, the bulk of the growing demand will fall on adjacent nondesignated areas which have a strong aesthetic appeal.[3]

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[1] Missouri Basin Inter-Agency Committee. The Missouri River Basin Comprehensive Framework Study. Denver, Colo.: U.S., Department of the Interior, Bureau of Land Management, 1971, Vol. 1, p. 137.

[2] In Hayden, Colorado (pop. 10,000), which is located in the middle of the Yampa coal field, snowmobiling is the most popular form of recreation. At least one, and often two snowmobiles can be found in every yard: "At one residence, there were four, lined up like bicycles." Gits, Victoria. "Boom Town on the Brink." Colorado/Business, Vol. 5 (February 1978), p. 32.

[3] An important limitation in projecting recreational demands is the difficulty of anticipating trends in recreational styles. For example, such technological innovations as snowmobiling are recent phenomena. Hydrofoil and shallow draft boats make many western rivers available for recreational use. Similarly, uncertainty exists in land management practices. Current trends are to increase restrictions on wilderness and backcountry areas, but economics encourages the Forest Service to promote dispersed recreation activities by building trails and improving access. See White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, p. 872; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

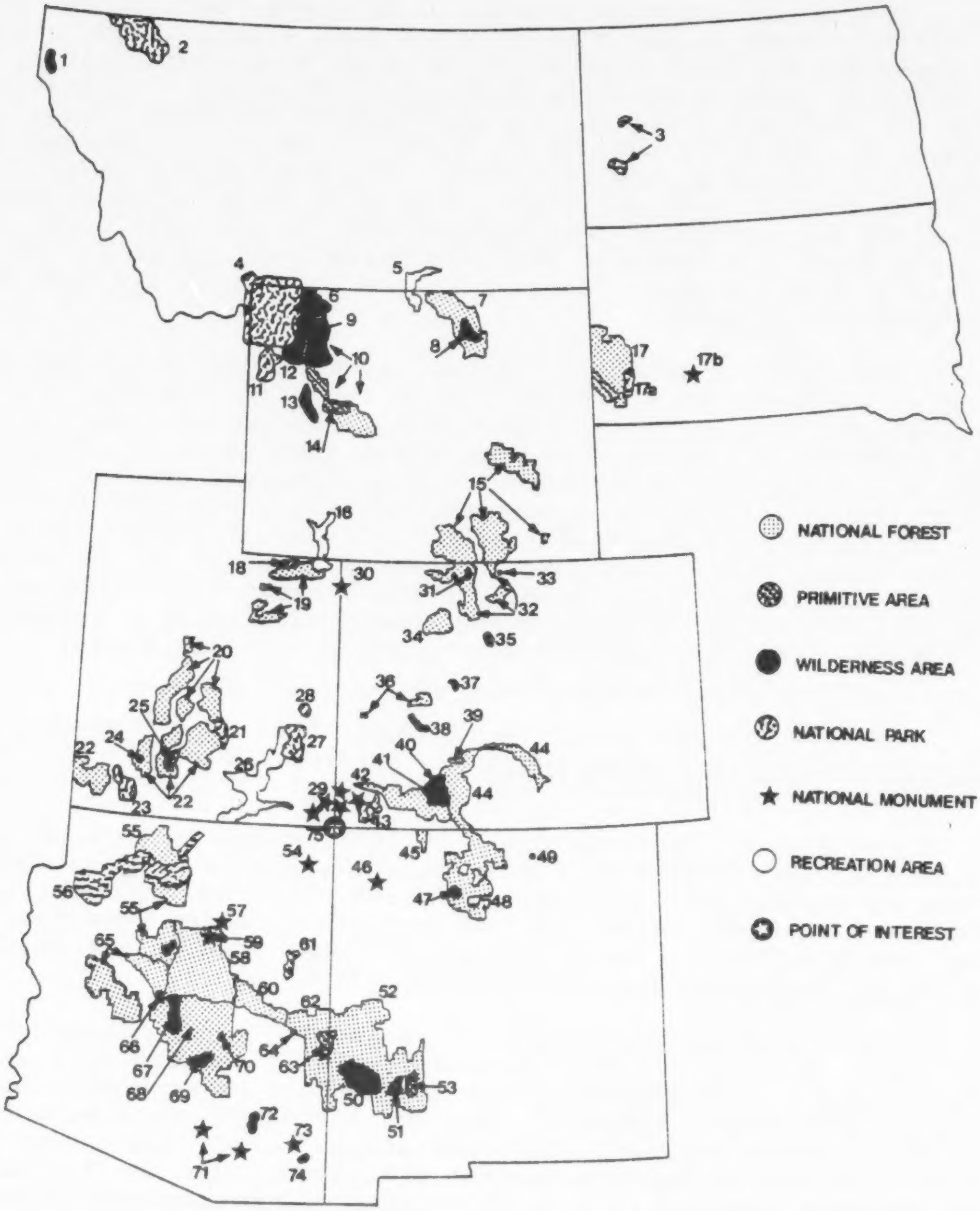
NATIONAL FOREST
PRIMITIVE AREA
WILDERNESS AREA
NATIONAL PARK
NATIONAL MONUMENT
RECREATION AREA
POINT OF INTEREST
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FIGURE 7-1: MAJOR BACK-COUNTRY AREAS LIKELY TO RECEIVE INCREASED PRESSURE DUE TO ENERGY DEVELOPMENT[a]

FIGURE 7-1: MAJOR BACK-COUNTRY AREAS LIKELY TO RECEIVE INCREASED PRESSURE DUE TO ENERGY DEVELOPMENT[a] (Continued)

[a]1. Cabinet Mountains WA
2. Glacier NP
3. Theodore Roosevelt NP
4. Yellowstone NP
5. Bighorn Canyon RA
6. N. Absaroka WA
7. Bighorn NF
8. Cloud Peak PA
9. Washakie WA
10. Shoshone NF
11. Grand Teton NP
12. Teton WA
13. Bridger WA
14. Popo Agie PA
15. Medicine Bow NF
16. Flaming Gorge RA
17a. Wind Cave NP
17b. Badlands NM
18. High Unitas PA
19. Ashley NF
20. Fishlake NF
21. Capitol Reef NP
22. Dixie NF
23. Zion NP
24. Cedar Breaks NM
25. Bryce Canyon RA
26. Glen Canyon RA
27. Canyonlands NP
28. Arches NP
29. Hovenweep NM
30. Dinosaur NM
31. Mt. Zirkel WA
32. Routt NF
33. Rawah WA
34. White River NF
35. Eagles Nest WA
36. Grand Mesa NF
37. Maroon Bells/Snowmass WA
38. Black Canyon of the Gunnison WA
39. La Garita WA
40. Upper Rio Grande PA
41. San Juan WA
42. San Juan NF
43. Mesa Verde NP
44. Rio Grande NF
45. Carson NF
46. Chaco Canyon NM
47. San Pedro Parks WA
48. Santa Fe NF
49. Wheeler Peak WA
50. Gila WA
51. Gila PA
52. Gila NF
53. Black Range PA
54. Canyon de Chelly NM
55. Kaibab NF
56. Grand Canyon NP
57. Wupatki NM
58. Coconino NF
59. Sunset Crater NM
60. Sitgreaves NF
61. Petrified Forest NP
62. Apache NF
63. Blue Range PA
64. Mr. Baldy WA
65. Prescott NF
66. Pine Mountain WA
67. Mazatzal WA
68. Tonto NF
69. Superstition WA
70. Sierra Ancha WA
71. Saquaro NM
72. Galiuro WA
73. Chiricahua NM
74. Chiricahua WA
75. Four Corners Area

WA = wilderness area
NP = national park
RA = recreation area
NF = national forest
PA = primitive area
NM = national monument

Other impacts resulting from population increases are similar to those caused by facilities. Increased housing, roads, and service activities fragment wildlife habitats into small parcels that are less usable either by resident or migratory species, and can cause some species to desert an area. Easier access to recreational areas can lead to increasing erosion, vegetation damage, damage to fish, birds, and other wildlife, and diminished enjoyment of resources. Based on patterns identified in our Energy From the West impact analysis reports, this is likely to occur in four areas: western Colorado and eastern Utah, the coal regions in Wyoming, the Four Corners area,[1] and the coal fields of Montana and North Dakota. In western Colorado, the large population influx is expected to locate near prime outdoor recreation areas (including national forests, parks, monuments, and wilderness/primitive areas).[2] Consequently, growing populations in this area will cause the most conflict with "national heritage" lands. The Wyoming and North Dakota areas will also experience substantial population increases; however, in these places, outdoor recreationists will be limited in their choice of recreation areas. The three closest such areas, Theodore Roosevelt National Memorial Park, Black Hills National Forest and Bighorn National Forest, are likely to receive greater use. Some evidence suggests that prime recreation areas are already becoming used intensively as a result of recent energy development (see box).

GOOD-BYE TO THE OLD DAYS

Grand Teton National Park is located 100 miles north of energy boomtown Rock Springs, Wyoming. Three million residents and out-of-state tourists visited the park in 1976. "Wyoming is feeling the effects of energy development," says State Senator John Turner. "It's doubled the population in some communities, brought in a rough crowd, caused an increase in mental health problems, divorce, alcoholism and crime." Due to these increases 70 percent of the respondents in a public opinion survey of residents of Jackson Hole (in the park) favored strong land-use controls and very limited growth.

--Leydet, Francois. "Jackson Hole: Good-Bye to the Old Days." National Geographic, Vol. 150 (December 1976), p. 771.

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[1] The energy-related population growth in Utah and New Mexico may affect such areas as San Juan National Forest (in Colorado), Chaco Canyon National Monument (New Mexico), and the Dixie National Forest and Glen Canyon National Recreation Area (Utah).

[2] For example, Rio Grande National Forest, San Juan National Forest, Rio Grande National Wilderness Area, Upper Rio Grande Primitive Area, Gore Range/Eagles Nest Wilderness Area, and Mesa Verde National Park.

C. Variations in Land-Use Impacts by Location

Land impacts may also vary according to several locational factors. For example, in the case of coal, the amount of land disturbed for each unit of energy extracted is highly dependent on the Btu content of the coal and its seam thickness. Table 7-4 shows that land requirements for mines at different sites vary considerably. Mining coal with a high Btu content and a thick coal seam disturbs less land than will mining low-Btu coal with a thin coal seam.

Climate, soil, topography, and existing biological communities at a site are also important locational features that affect the extent and type of land impacts. These factors are significant particularly because they affect the cost and potential success of reclamation.

Rainfall, including its seasonal distribution, is one of the most important climatic variables affecting the reclamation of

TABLE 7-4: LAND USE FOR MINES FOR SIX SPECIFIC LOCATIONS[a]

TYPE	SITE[b]	TYPICAL SIZE MINE[c] (acres over 30 years)	EQUIVALENT ENERGY (acres per 10^{12} Btu)
Surface Coal	Navajo/Farmington	4,000 - 27,820	.5 - 3.2
Surface Coal	Gillette	4,030	0.5
Surface Coal	Colstrip	9,680	1.2
Surface Coal	Beulah	24,210	3
Underground Coal	Kaiparowits	1,700	0.2
Underground Oil Shale	Rifle	4,200	0.5

Btu = British thermal units

[a] Average includes all surface lands disturbed, including disposal of wastes such as spent oil shale.

[b] Seam thickness and heating values assumed: Navajo/Farmington - 10.3 feet between 1 and 7 multiple seams, 8,600 Btu per pound; Gillette - 64 feet, 8,000 Btu per pound; Colstrip - 28 feet, 8,600 Btu per pound; Beulah - 13 feet, 6,950 Btu per pound.

[c] In all cases the mine size assumed supports a 3,000 megawatts-electric power plant.

mined lands. Average rainfall and seasonal distribution data for three areas in the region are given in Table 7-5. The Southwest receives the least amount of rainfall overall; the Rocky Mountain region and Northern Great Plains have similar total rainfall, but during the summer growing season, rainfall in the Northern Great Plains is twice that of the Rocky Mountains. A comparison of Tables 7-4 and 7-5 suggests an important land-use problem. For a mine supplying a 3,000 megawatts-electric power conversion facility, the amount of land requiring reclamation is generally largest in the Southwest which also happens to be the area with the least average annual rainfall.

TABLE 7-5: PRECIPITATION AVERAGES IN THE WEST

REGION	PRECIPITATION[a] (inches)		
	WINTER	SUMMER	ANNUAL
Northern Great Plains	<5	10-20	10-20
Rocky Mountains	5-10	5-10	10-20
Southwest	<5	<5	<10

< = less than

[a] Espenshade, Edward B., ed. Goode's World Atlas, 13th ed. Chicago, Ill.: Rand McNally, 1971. Winter corresponds to November 1/April 30; summer corresponds to May 1/October 31.

The semiarid climate and good topsoil of the Northern Great Plains provide for an ecosystem that can be restored with less difficulty than in the Southwest. Forest areas of the Rocky Mountains are more difficult to restore due to difficult topography and the long time required to establish a mature forest. In deserts, infrequent rainfall and overgrazing by livestock limit the success of reclamation efforts. For example, reclamation success in the arid Black Mesa area that does not have a source of irrigation is almost nonexistent.[1] But through irrigation, the Navajo and San Juan mines near Farmington in northwest New Mexico have established vegetation in some areas with greater cover than exists in adjacent unmined areas.[1] Still unanswered, however, is whether reclaimed areas will remain productive. In part, this is because problems are unresolved concerning the effects of phasing out water supplements on arid sites. Even in semiarid places, such as the coal mining areas of Decker, Montana and Carbon County, Wyoming, withdrawing irrigation and fertilizer supplements may be difficult because of unfavorable spoil and soil properties. The Bureau of Land Management (BLM), Bureau of Reclamation, and U.S., Geological Survey (USGS) recommend that supplemental irrigation should not be used in the revegetation plan for land in the Hanna Basin of Wyoming unless all other methods for establishing vegetation fail.[2] This recommendation was based principally on an assessment of the shock to established stands of vegetation cover once irrigation and fertilizer were removed after a period of intensive use (e.g., three years).[3] Reclamation research at Forest Service experiment stations and in agriculturally-oriented university research centers is being conducted with regard to the potential of returning mined lands to productive uses.[4]

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[1] Gordon, Suzanne. Black Mesa: The Angel of Death. New York, N.Y.: John Day, 1973, p. 68; Goodman, Jim. The Navajo Nation and Energy Development: A Study of the Cultural, Social and Political Environments, Draft, Sub-Contract Report to Science and Public Policy Program. Norman, Okla.: University of Oklahoma, Science and Public Policy Program, September 1977.

In sum, using present reclamation techniques, areas with 6-10 inches of rainfall per year can generally support plant regrowth without supplemental irrigation.[5] Annual precipitation levels on strippable land in northeastern New Mexico, southwestern Wyoming, and south-central Utah often fall below 10 inches. However, based on the results of several years of investigating revegetating mining spoils, the U.S. Forest Service has found that when "mined and graded with care, and planted properly to suitable species, areas receiving as little as 6 inches average annual precipitation have been revegetated." However, the key words here are "with care," "properly," and "suitable species."[1] Interpretation of each of these requires consideration of site-specific characteristics.

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[1] Annual precipitation rates at the Navajo mine of approximately six inches have called for the use of supplemental water for at least 1.5 years. U.S., Environmental Protection Agency, Office of Energy Activities, Region VIII, et al. Surface Coal Mining in the Northern Great Plains of the Western United States: An Introduction and Inventory Utilizing Aerial Photography Collected in 1974 and 1975. Denver, Colo.: U.S., Environmental Protection Agency, 1976.

[2] See Farmer, E.E., et al. Revegetation Research on the Decker Coal Mine in Southeastern Montana, Research Paper INT-162. Ogden, Utah: U.S., Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, 1974, p. 10.

[3] U.S., Department of the Interior, Bureau of Land Management. Resource and Potential of Reclamation Evaluation: Hanna Basin Study Site, EMRIA Report No. 2. Rawlins, Wyo.: Bureau of Land Management, 1975, p. 172.

[4] Davis, Grant, Associate Program Manager for Research, Surface Environment and Mining Program (SEAM), Forest Service, U.S., Department of Agriculture. Personal communication, 1977; McKell, Cy, Utah State University. Personal communication, 1977; and Grogan, Sterling, Utah International. Personal communication, 1977. All appear to be optimistic.

[5] National Academy of Sciences. Rehabilitation Potential of Western Coal Lands, a report to the Energy Policy Project of the Ford Foundation. Cambridge, Mass.: Ballinger, 1974, p. 2.

The timing of the precipitation appears to be much more critical than the average annual precipitation.[2] If most of the moisture occurs during the winter and practically none occurs during the growing season, reclamation practices may be further constrained by the need for and cost of irrigation, by wind erosion, and by other factors.[3] In addition, periodic dry periods lasting up to several years curtail successful revegetation unless irrigation can be provided.[4]

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[1] Davis, Grant, Associate Program Manager for Research, Surface Environment and Mining Program (SEAM), Forest Service, U.S. Department of Agriculture. Personal communication, 1976.

[2] This is stated in the National Academy of Sciences (NAS) study referred to earlier and is noted in Grant Davis's personal communication. In his comments on the NAS report, Robert R. Curry, Associate Professor of Environmental Geology from the University of Montana, stated: "Both soil formation and plant growth rely upon soil moisture, not rainfall, and in the arid west rainfall bears relatively little relationship to soil moisture. In addition to summer rainfall, concomitant summer evaporation which reduces soil moisture must be considered." Reviewer comments in National Academy of Sciences. Rehabilitation Potential of Western Coal Lands, a report to the Energy Policy Project of the Ford Foundation. Cambridge, Mass.: Ballinger, 1974, p. 168.

[3] The Forest Service has been working with supplementary irrigation and finds that such equipment should be available for use as insurance against long dry periods regardless of average annual precipitation in the West. Davis, Grant, Associate Program Manager for Research, SEAM, Forest Service, U.S. Department of Agriculture. Personal communication, 1976.

[4] NAS. Rehabilitation Potential of Western Coal Lands; Packer, Paul E. Rehabilitation Potentials and Limitations of Surface-Mined Land in the Northern Great Plains, General Technical Report INT-14. Ogden, Utah: U.S., Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, 1974.

7.2.2 The Context of Land-Use and Reclamation Issues in the West

Although the problems and issues addressed here are likely to become more intense as western energy development proceeds, they are by no means entirely new. In several instances, they have been before the public for most of this century: for example, the problems and issues related to developing appropriate mining laws, or in making public lands available for other private or public uses. In other instances, policy debates associated with land use are relatively new, such as recent federal regulations for developing and implementing state reclamation programs.

Existing laws and regulations, institutions, and values and interests of involved participants make up the context within which energy-related land issues are evolving. This context affects how conflicts are being dealt with and how new problems and issues will be handled. Consequently, the discussion below summarizes key elements in the historical development of land-use policies and issues. It is organized around three general themes: the role of government in planning and controlling land use; the objectives and requirements of postmining reclamation; and accommodating and controlling recreational and agricultural uses of public lands.

A. Planning and Managing Land Use

Conflicts in planning and managing land use in development areas have surfaced not only on the basis of findings in this technology assessment, but also on the basis of analyses conducted by other policy research groups. For example, the Task Force Report sponsored by the Rockefeller Brothers Fund found that a central problem confronting both the entire U.S. and the West specifically, was the unrestricted patchwork of urbanization and development that sprawls across scenic hills, valleys, forests, and farms.[1] Indeed, managing growth and planning land use have already become major political issues in some western states, and account in part for differences in public attitudes about potential energy development in western states, between Colorado and Utah, for example.[2] Furthermore, federal legislation to manage both state and federal lands has been before Congress during three of the past four legislative sessions.

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[1] See Reilly, William K., ed. The Use of Land: A Citizens' Policy Guide to Urban Growth. New York, N.Y.: Thomas Y. Crowell, 1973.

[2] Gill, Douglas. "Utah Seeks Federal Okay to Set Own Pollution Level." Denver Post, December 19, 1976.

(1) Multiple Interests in Land-Use Planning

Land-use policy has undergone substantial change in the U.S., ranging from a trial and error approach during early colonization and development, through periods when management and stewardship were more important considerations, to recent periods where zoning and planning have been emphasized. In each of these periods, policymakers have responded to conflicts between divergent interests such as the needs of homesteaders, mining companies, conservationists, and those interested in preservation of naturally scenic or historically significant areas.[1]

Industry interests, including energy and mining companies, have played a major role in affecting land-use policies. In the eight western states, firms such as Kennecott Copper, Utah International, Anaconda, and others have attempted to maintain unrestricted access to minerals on both public and private lands. These companies typically work closely with western congressmen to maintain or expand their interests.[2] In general, mining industries have played a major role in either defeating or limiting attempts at restrictive land-use planning, and have promoted legislation which permit free access to federal lands.[3]

During the 19th century when environmental impacts on land were for the most part ignored, the only government policy for mineral lands was one of "noninterference." The Mining Act of 1866[4] legitimized this policy by declaring the public domain[5] to be "free and open" to exploration for minerals and mining. The General Mining Law of 1872[6] clarified some procedural ambiguities in the 1866 Act. It allowed a claim to be filed and a patent granted for the use of federal lands irrespective of any consideration of specific land use. Since stringent controls were not placed on the use of public lands, mining industries enjoyed a period of rapid growth. Once minimum and perfunctory criteria were met, public lands passed into private ownership.

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[1] Stairs, Gerald R. "Land-Use Planning: An Overview," in Thames, John L., ed. Reclamation and Use of Disturbed Land in the Southwest. Tucson, Ariz.: University of Arizona Press, 1977, p. 3.

[2] Peirce, Neal R. The Mountain States of America. New York, N.Y.: Norton, 1972, p. 205.

[3] Jones, Douglas N., et al. The Energy Industry: Organization and Public Policy. Washington, D.C.: Government Printing Office, 1974.

[4] Mining Act of 1866, 14 Stat. 251.

[5] The public domain is lands, either acquired by the federal government during the expansion of the West or purchased from private owners.

[6] General Mining Law of 1872, 17 Stat. 91.

By the late 1890's and early 1900's, it was recognized that the government's resource disposal policies were being abused.[1] Reservation and withdrawals of public lands followed, beginning the modern era of viewing these lands as a resource to be managed and conserved. Congress also allowed nonmineral entries (such as farming) on public lands, first on coal lands,[2] then on lands bearing all types of minerals.[3] Between 1914 and 1920 Congress was under increasing pressure to open public "withdrawn" lands to mineral development. This six-year period of debate and recognition of the inequities of limited management made the need for a comprehensive leasing system clear, leading to the passage of the Mineral Leasing Act of 1920.[4] This act established a system for leasing "soft minerals" such as coal, oil, and gas on public lands. A primary impetus behind this Act was the wish to encourage competition and receive some compensation for the use of federal coal lands.

Numerous congressional acts and executive policies have restricted the availability of federal lands for minerals exploration and development. The Department of the Interior (DOI) estimates that on about 40 percent of federal lands, energy development activities have been prohibited.[5] In addition, another 20 percent are restricted so that energy resource exploration and development appears unlikely. Since 1968 the total for federal lands on which formal restrictions or prohibitions pertain has increased from 20 percent to more than 50 percent of all federal lands.[6] This increase is due primarily to the establishment of wilderness areas and temporary land withdrawals in Alaska.

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[1] Beard, Daniel P. "Public Policy Milestones in the Development of the Oil Industry," in Jones, Douglas N., et al. The Energy Industry: Organization and Public Policy. Washington, D.C.: Government Printing Office, 1974.

[2] 35 Stat. 844 (1909), 36 Stat. 583 (1910), 37 Stat. 105 (1912).

[3] 38 Stat. 509 (1914).

[4] Mineral Leasing Act of 1920, 41 Stat. 437. Lands subject to the Mineral Leasing Act for Acquired Lands of 1947, 61 Stat. 913, 30 U.S.C.A. 351-59 are also covered by the 1920 Act.

[5] U.S., Department of the Interior. Mining and Minerals Policy, 1976 Annual Report of the Secretary of the Interior. Washington, D.C.: Government Printing Office, 1976, p. 27.

[6] Ibid.

In sum, there is currently less land available for the exploration and development of domestic energy resources than has historically been the case.

These restrictions raise a number of policy problems and issues. In making decisions regarding development, policymakers must weigh the advantages of energy production against disadvantages to the public. However, such determinations are difficult and most estimates are uncertain. Congress attempted to deal with this problem by calling on the BLM and USGS to evaluate the mineral values in wilderness areas. These resource appraisals are to assist policymakers in choosing among different land uses.

Recent initiatives for land-use legislation have come from both the executive branch and from Congress. Members of Congress from western states have been heavily involved in these actions. For example, former Colorado Representative Wayne Aspinall was active as chairman of the Public Land Law Review Commission, and author of the National Land Policy, Planning and Management Act (HR 7211) proposed in 1972. Although no action was taken on the bill, the bill reflected recognition of the need to coordinate efforts between federal agencies, other landowners, state and local governments, and private individuals.[1]

A number of public interest groups support comprehensive land-use legislation, including the National Wildlife Federation, National Audubon Society, and Sierra Club (see box). However, these groups, the Isaac Walton League and Friends of the Earth, have opposed some of the land-use bills that have been introduced recently because they believe that the proposed planning, funding, and review procedures

IMPLEMENTING ENVIRONMENTAL OBJECTIVES

Groups like the Sierra Club implement their objectives through the courts, by lobbying and through technical review. The Sierra Club Legal Defense Fund has been instrumental in delaying development for several years of Northern Great Plains Coal in Sierra Club v. Morton. This case called for the Department of the Interior to file an environmental impact statement (EIS) for the regional development of coal. Following several years of litigation, the Supreme Court ruled in 1976 that an EIS was not required. The Department of the Interior, however, is proceeding on regional EIS's at this time.

--Sierra Club v. Morton, 507 F. 2nd 533 (District Court D.C. 1975), affirmed, 514 F. 2nd 856 (D.C. Cir. 1975).

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[1] Congressional Quarterly, Inc. Congress and the Nation, Vol. III: 1969-1972. Washington, D.C.: Congressional Quarterly, 1973, 809-10.

were oriented to commercial exploitation of public lands rather than to their preservation and conservation. In addition, many environmental organizations criticized the 1970 report of the Public Land Law Review Commission as supporting land-use concepts that would sacrifice soil, water, wildlife, and aesthetic values to mining, grazing, and logging interests[1] (see box).

Although land-use planning on federal lands is obviously a dominant issue in western energy development, states and localities have traditionally been the locus of land-use control. Historically, wide ranging authority has been delegated by states to communities. Since energy development will stress the capabilities of existing institutional arrangements at these levels as well as at the federal level, several additional issues are outlined below.

THE GOSPEL HUMP WILDERNESS

Although the federal bureaucracy is often called upon to mediate conflicts between diverse interests, a Sierra Club spokesman reported an opposite effect following meetings with the timber industry. The limitations of government were discovered during negotiations over the boundaries of the Gospel Hump wilderness in the Northwest. Negotiations only proved to be successful after the industry and environmental participants agreed to exclude representatives of the Forest Service and a state fish and game agency.

--Carter, Luther J. "Coal: Invoking the Rule of Reason in an Energy-Environment Conflict." Science, Vol. 198 (October 21, 1977), p. 279.

Local governments typically have discretionary authority that goes beyond mere zoning tools. They also may legislate against public nuisances, adopt subdivision regulations and building codes, institute solid waste management plans and regulations, require open space areas for parks and recreational facilities, apply floodplain regulations and environmental controls, establish housing commissions or development authorities, and create special purpose districts to attempt to deal more effectively with development.[2] Yet, local efforts are seldom adequate to cope with regional (and ultimately statewide or national) impacts or planning needs. This is compounded by the fact that much of the land in rural energy development areas is unincorporated.[1]

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[1] Congressional Quarterly, Inc. Congress and the Nation, Vol. III: 1969-1972. Washington, D.C.: Congressional Quarterly, 1973, pp. 809-10.

[2] Council of State Governments, Task Force on Natural Resources and Land Use Information and Technology. Land: State Alternatives for Planning and Management. Lexington, Ky.: Council of State Governments, 1975, pp. 4-6.

Many western states have established additional planning requirements. For example, Wyoming and North Dakota now require local governments to appoint planning commissions and engage in comprehensive planning. Colorado and Wyoming have state land-use commissions. Colorado has a permit system that requires a facility to be approved in accordance with a county land-use commission's guidelines or regulations. In 1975 Montana passed a law that calls for subdivisions to be in "harmony" with their environment. Wyoming's state land-use planning act requires state and local land-use plans and requires coordination with the Industrial Siting Board via the State Land-Use Commission.[2]

A number of other state and local agencies affect land uses. Attempts to coordinate programs at the state level are typically through the Office of Management and Budget Circular A-95 process established in the mid-1960's. Substate planning districts in most states coordinate Environmental Protection Agency (EPA) programs in wastewater and drinking water treatment, and area-wide wastewater management planning. Together with other federal programs, the intent of the substate planning districts is to establish an organized review process, although the planning has had limited effectiveness, and has had only a minimal effect on decisionmaking.[3]

(2) Diversity of Land Uses

Minerals that are frequently located in forest, range, or farm areas raise concerns about the most appropriate of alternative uses of the land. Although multiple uses[4] may be encouraged, it is more typical that one use threatens another. These conflicts are usually expressed in terms of individual occupational interests. Ranchers and farmers are troubled over competition for land and water, about the loss of agricultural water to energy development, and about the impact of increasing air pollution on grasslands, crops, and other natural resources.[1]

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[1] For more discussion of this point, see Chapter 9 on Growth Management.

[2] Relevant state statutes for these examples are given in White, Michael D. "Constitutional Derivation and Statutory Exercise of Land Use Control Powers," in Rocky Mountain Mineral Law Foundation. Rocky Mountain Mineral Law Institute: Proceedings of the Twenty First Annual Institute, July 17-19, 1975. Albany, N.Y.: Matthew Bender, 1975, pp. 695-97.

[3] Council of State Governments, Task Force on Natural Resources and Land Use Information and Technology. Land: State Alternatives for Planning and Management. Lexington, Ky.: Council of State Governments, 1975, p. 27.

[4] Multiple use refers to simultaneous utilization of the surface or subsurface of a tract of land for more than one ongoing productive purpose, including recreation, energy development, timber harvesting, agriculture, and grazing.

Of special concern are prime farmlands and alluvial valleys in the Northern Great Plains region. Together these lands are usually the most productive, support local cattle ranches and dairy farming, and help provide good hay crops. Agriculture in Montana and Wyoming is particularly dependent on alluvial valley floors.

Questions about appropriate land uses also include attempts by conservationists to protect the natural beauty of the landscape and environment. Long valued for its aesthetics and pristine condition, the region could undergo significant transformation if a high percentage of its energy resources were to be utilized. Many environmentalists fear that ill-planned and uncoordinated development would threaten these aesthetic qualities.[2]

As shown in the previous section, although comprehensive land-use control laws have been considered, only public land-use planning has been initiated. Public planning has been undertaken principally through the BLM within the DOI and the Forest Service in the Department of Agriculture.

Bureau of Land Management

BLM has primary responsibility for administering resources on public domain and acquired federal lands and is the surface management agency for most federal lands (except National Forests; Parks, and Indian Reservations). The Federal Land Policy and Management Act of 1976[3] requires BLM programs to provide for land management which promotes "multiple use and sustained yield" while maintaining and enhancing the quality of the environment. It requires the development of comprehensive land-use plans for BLM lands and authorizes Congress to veto any decision to exclude "from one or more principal uses a tract of 100,000 acres or more for two years or longer."[1] Principal uses are defined as domestic livestock grazing, fish and wildlife development, mineral exploration and production, rights-of-way, timber production, and recreation.

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[1] Grim, Elmore C. "Environmental Assessment of Western Coal Surface Mining," in Proceedings of National Conference on Health, Environmental Effects, and Control of Energy Use. Washington, D.C.: U.S., Environmental Protection Agency, 1976, pp. 177-78.

[2] See, as one example, Josephy, Alvin M., Jr. "Kaiparowits: The Ultimate Obscenity." Audubon, Vol. 78 (Spring 1976), pp. 64-90.

[3] Federal Land Policy and Management Act of 1976, Pub. L. 94-579, 90 Stat. 2743.

BLM plans and makes available coal lands for development through an industry and government nominating system that also considers market interest for new coal production. A recent court suit brought by the Natural Resources Defense Council caused a moratorium on the sale of new coal leases by the government.[2] The Bureau's "Energy Minerals Allocation Resource System" (EMARS) is currently under review, and the DOI is examining existing leases and applications to determine if production is environmentally acceptable.[3] Based on these reviews, BLM is not likely to resume coal leasing activities at least until 1980.[4] However, oil, gas, and geothermal resource leasing programs are continuing, as is the evaluation of uranium mining claims.

Forest Service

The Forest Service in the Department of Agriculture is a surface management and research oriented agency. It manages surface lands in close cooperation with developers. The National Forest Management Act of 1976[5] established standards and guidelines for Forest Service land-use plans and revised federal policy towards managing national forest resources.

Both the Federal Land Policy and Management Act and the Forest Management Act are intended to develop more comprehensive land-use planning for federal lands. They both address the range of competing interests and conflicts that result in managing for multiple uses. Even so, neither of these recent laws appears able to deal with problems and issues relative to prospecting and claims procedures of the 1872 Mining Law.[1] For uranium, public domain lands under jurisdiction of a surface management agency subsequently move from federal to private ownership. Under these circumstances almost all uranium lands are under state control.[2]

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[1] Congressional Quarterly, Inc. Congress and the Nation, Vol. III: 1969-1972. Washington, D.C.: Congressional Quarterly, 1973, p. 314.

[2] For a discussion of the moratorium, see Chapter 2.

[3] "Interior May End EMARS Leasing." Old West Regional Bulletin, Vol. 4 (August 1, 1977), p. 4.

[4] Rattner, Steven. "Tough Task in Implementing Crippled Energy Plan." New York Times National Economic Survey, January 8, 1978, Section 12, p. 13.

[5] National Forest Management Act of 1976, Pub. L. 94-588, 90 Stat. 2949.

The 1964 Wilderness Act, which established a national wilderness preservation system, is also managed by the Forest Service. This act will eventually close millions of acres of federal land to energy resource development. On January 1, 1984, lands which the Forest Service has designated as wilderness areas will be withdrawn from mining and leasing laws. Although minerals exploration and production is not now formally prohibited on these withdrawn lands, the risk associated with attempts to bring development online by 1984 has already severely restricted energy development ventures for these areas.[3] In addition, proposed wilderness areas managed by the Forest Service, e.g., primitive and roadless areas, have been identified for possible inclusion in the wilderness system.

Evaluation of wilderness and roadless areas to be withdrawn from development is the focus of the Forest Services ongoing Roadless Area Review and Evaluation (RARE) program. "RARE II" which delineates the most recent classification of these lands proposed the addition of some 67 million acres (104,688 square miles) to the wilderness/roadless system.[4] Included in these lands are forest lands which had been classified as commercial timberland. Representatives of the timber industry have questioned the single-use wilderness designation in view of the historical multiple-use concept whereby industry and recreationists shared use of the national forests.

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[1] Forest management provisions are generally considered to be more favorable to the timber industry than to environmentalist. See Congressional Quarterly, Inc. Congress and the Nation, Vol. III: 1969-1972. Washington, D.C.: Congressional Quarterly, 1973, p. 313. This issue is discussed below in Subsection "B," on land reclamation.

[2] Also, a number of uranium lands are on Indian Reservations under Indian, Bureau of Indian Affairs, and USGS management.

[3] U.S., Department of the Interior. Mining and Minerals Policy, 1976 Annual Report of the Secretary of the Interior. Washington, D.C.: Government Printing Office, 1976, p. 90.

[4] Wilkinson, Bruce. "Timber Groups Decry Shrinkage in Product Base." Denver Post, November 1, 1977

National Park Service

The National Park Service, administering agency for the National Park System, has an ongoing planning process to develop "General Master Plans" for the various parks under its control. The Resources Management Plan, one part of the General Plan, deals specifically with mineral development activities. In general, mining is prohibited in National Parks; however, the Secretary of the Interior does have authority to allow utilization of resources in certain recreation areas. For this to occur, it must be demonstrated that energy development activities will not "conflict or significantly impair recreation and the conservation of the scenic, scientific, or other values of any park in the National Park System."[1]

B. Objectives and Requirements of Land Reclamation

Questions of land reclamation are closely tied to issues of planning and managing land uses. Given the competing uses and need for large quantities of land, reclamation objectives and requirements are probably among the most critical problems and issues associated with western energy development. That is, if mined lands can be "satisfactorily" restored, conflict presumably would be reduced.

Public interest concerning the effects of mining, conversion, and waste disposal on land is manifested in a number of general and more specific concerns. A general concern is the "irreversibility" of mining decisions--the possibility that the land will be modified in a way that will make the land be of irreversibly lower value to society. As indicated in the description of impacts earlier, it is possible that, without adequate reclamation, future land-use alternatives will be lost and that severe ecological damage will result.

A specific concern is the effect of mining on water. Coal seams and oil shale deposits are major sources of groundwater for a variety of domestic and livestock uses. Consequently, surface mining can affect the availability and quality of water for farms and ranches. Mining interests may also conflict with other environmental values if reclamation objectives are not carefully prescribed and enforced. For example, improperly restored lands have a lower aesthetic value to those who want to protect the natural ecology and topography of an area.

All of these concerns are compounded by legal and administrative arrangements for land management and reclamation.

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[1] Moore, Russell, and Thomas Mills. An Environmental Guide to Western Surface Mining, Part One: Federal Leasible and Locatable Mineral Regulations. Washington, D.C.: Government Printing Office, 1977, p. 64.

Requirements for restoring lands affected by energy development differ according to resource and jurisdiction. In the case of surface coal mining, this issue has been on the public agenda for decades, and more uniform regulations for coal mine reclamation have recently been made (see below). However, reclamation objectives and requirements vary widely for other minerals. Even with coal, the limited knowledge of the probability of successfully reclaiming, and the trade-offs associated with this diversion, are perceived differently by various stakeholders.

Revegetation efforts have generally involved both "native" and "introduced" species. Some reclamation policies call for the use of native species because they are well adapted to the conditions that exist at the reclamation site. But limited availability of seeds for native vegetation in arid and semiarid locations may limit the use of native species.[1] Also, some reclamation efforts use introduced species because they germinate and grow more quickly. However, it is uncertain whether or not introduced species will persist and become a component in the ecosystem. Problem "weeds" frequently colonize and outcompete other species used in revegetation and are not suitable as food for wildlife or livestock.

(1) Policies for Reclaiming Disturbed Lands

From the beginning of mining activities in the 19th century, western mining companies have done some reclaiming of mined lands, but with few controls by government agencies. Until the early 1970's governments at all levels largely ignored reclamation problems. During the 1970's a majority of western states enacted legislation to require reclamation provisions as summarized in Table 7-6.

The most sweeping changes in reclamation law came in 1977 with the passage of the Surface Mining Control and Reclamation Act,[2] which called for state implementation of surface mining standards for coal extraction. The specific intent of the act is to provide minimum uniform standards to regulate mining. Lobbying for this type of surface mining law during the last several sessions of

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[1] Wyoming mine official. Personal communication, 1977. While limited availability of seeds is often a problem for some species needed for revegetation, not all native seeds are in short supply. Instead the most significant problem is that wild seed must be collected in the same general area where it will be planted. Streeter, Robert G., Coal Research Manager, Fish and Wildlife Service, U.S., Department of the Interior. Personal communication, 1977.

[2] Surface Mining Control and Reclamation Act of 1977, Pub. L. 95-87, 91 Stat. 445.

TABLE 7-6: COMPARISON OF STATE SURFACE MINING RECLAMATION LAWS[a]

SUBJECT	COLORADO	MONTANA	NEW MEXICO	NORTH DAKOTA	SOUTH DAKOTA	UTAH	WYOMING
Title of Law	Colorado Mined Land Reclamation Act (1973), amended 1976	The Montana Strip and Underground Mine Reclamation Act of 1973	Coal Surface-mining Act (1972)	Chapter 38-14 of ND Century Code, Reclamation of Strip Mined Land (1969)	Surface Mining Land Reclamation Act (1971)	Utah Mined Land Reclamation Act (1975)	Wyoming Environmental Quality Act (1973)
Minerals Regulated	All minerals excluding oil, gas, and geothermal	Coal, uranium	Coal	Coal	Coal and other minerals	All minerals	Coal, uranium, oil shale, irons, and other materials
Lands Designated Unsuitable for Mining	State park system, recreation lands, unreclaimable lands	Unreclaimable lands; natural watersheds, scientific areas	None	Unreclaimable lands; natural watersheds, scientific areas	Unreclaimable lands; ecologically important lands	None	Unique values
Administering Agency	Mined Land Reclamation Board	Department of State Lands	Coal Surface-mining Commission	Public Service Commission	Division of Conservation (Agriculture) and Conservation Commission	Division of Oil, Gas and Mining, Department of Natural Resources	Department of Environmental Quality, Land Quality Division
Reports Required	Permit application: map and reclamation plans; annual reclamation data	Mining and reclamation plan w/ permit application; annual reports	An initial mining plan; reclamation annual reports	Initial mining and reclamation plans annual map and report	Initial report on on reclamation procedures annual report	Reclamation plan; annual progress reports	Mining and reclamation plan w/permit application; annual progress report
Permits	Permit required; valid for life of the mining operation	Permit required is valid for one year	Permit required is valid for life of operation	Permit issued for extended (10-yr +) period	Permit required, must be renewed annually	Motion of intention and reclamation plus required	Permit required valid for life of operation
Bond	Surety required, amount determined by the Board	Not less than $200 or more than $2,500/acre	At the discretion of the Commission	Determined by Commission; minimum bond, $1,500/acre	Determined by the the Commission	Surety required	Equal to estimated reclamation cost

TABLE 7-6: (Continued)

SUBJECT	COLORADO	MONTANA	NEW MEXICO	NORTH DAKOTA	SOUTH DAKOTA	UTAH	WYOMING
Consent of Surface Land Owner Required	Yes, by requiring right of entry	Yes	No	No	No, but landowner must be consulted on reclaimed use	No	Yes
Reclamation Time Limitation	Completed five years after initiated	As rapid as possible	In a reasonable amount of time	Reclamation must be completed three years	Begin as soon as possible	Concurrently or in a reasonable amount of time	Earliest possible time
Backfilling/ Grading	Final topography appropriate to the land use	Restored to approximate original contour; topsoil to be replaced	To be defined in regulations	Regrade to approximate original contour	Retain contour basis, replace overburden and topsoil	None	Land use at least equal to highest previous use
Revegetation Land Use	Subject to approval by the board and landowner	Diverse permanent cover capable of withstanding grazing	To be defined in regulations	Respread suitable plant growth material to a maximum of five feet	Requirements detailed in promulgated rules	Return to a condition compatible with past, present and probable future use	Topsoil shall be reused, revegetation consistent with surrounding terrain and use

Source: Federation of Rocky Mountain States, Inc. *Summary of Surface Mining Reclamation Laws in the Mountain-Plains States.* Regional Background Paper from the Rocky Mountain States. Denver, Colo.: Federation of Rocky Mountain States, 1976, pp. 9-14.

[a] As of 1978, Arizona did not have a law regarding surface mining reclamation.

Congress by a coalition of environmentalists' groups was intense. Opposition by the National Coal Association and other industry groups was equally intense. Most minerals, including oil, gas, oil shale, and uranium, are still not covered by a uniform reclamation policy.

Strongly supported by Secretary of the Interior, Cecil Andrus, the Surface Mining and Reclamation Act of 1977 substantially changes the federal role in controlling coal surface mine reclamation.[1] The principal objective of the act, as indicated by House Interior Committee Chairman Udall of Arizona, is to provide a uniform system of restoring strip mined lands to approximately original conditions. As shown in Table 7-7, the act established an Office of Surface Mining Reclamation and Enforcement (OSM) in the DOI, with responsibility for developing detailed reclamation performance standards. It also establishes an Abandoned Mine Reclamation Fund, requires reclamation plans to provide for public hearings and citizens suits, and outlines procedures for designating lands unsuitable for mining.

Strip mining of highly productive farmland was a controversial element of the new law. Environmentalists and some agricultural interests had sought to prohibit any strip mining of farmlands. Coal industry lobbyists argued that the land could be restored and made even more useful after reclamation. As a compromise, the act permits mining of "prime farmlands" and in alluvial valleys when the developer can show that the proposed mining operations would not preclude farming and not adversely affect the quantity of water in the valley floor system.[2] Surface owner consent is required before mining can take place on federal strippable lands beneath an owner's land. Finally, revegetation and restoration to original topography is generally required except in rare circumstances (see box "Modifying Topography").

The act also provides uniform reclamation standards on all lands whether federal or not, and assigns states management and enforcement responsibility. Officials of the OSM are to inspect periodically all mines and report on the progress of reclamation work. Regardless of where produced, a tax on mined coal is used to

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[1] Although its title does not indicate it, the legislation covers both the adverse effects of surface mining and, to a lesser extent, the surface impacts of underground coal mining operations. But there is no broad legislation addressing subsidence in the way surface mine reclamation is addressed.

[2] However, the law does not include grazing pasture or hay meadows in its definition of "prime farmland" where special reclamation provisions will apply. See "Farm Land Mining Standards Studied." Denver Post, February 1, 1978.

TABLE 7-7: SELECTED REQUIREMENTS OF THE SURFACE MINING CONTROL AND RECLAMATION ACT OF 1977

Scope:	Coal resources that are surface mined (some coverage of surface activities of underground mines), requires studies of reclamation needs of other minerals, and provides method of designating areas as unsuitable for mines over two acres.
Institutions:	Establishes an Office of Surface Mining Reclamation and Enforcement (OSM) in the Department of the Interior
Abandoned Mine Fund:	Establishes a fund based on a coal tax of 35 cents per ton for surface mined coal, 15 cents/ton for underground coal, and 10 cents/ton for lignite. Fifty percent of the fund goes to states for their reclamation needs.
Implementation/ Monitoring:	States implement the plan with approved programs. States inspect and monitor. At least two Federal inspections at each mine each year, plus inspections at certain inactive mines.
Procedures:	All surface coal mines require a permit. The permit has reclamation plan requirements, hearing, approval and denial procedures, and provision for revised plans. Posting a reclamation bond is required. Inspection is provided with administrative and judicial review.
Citizen Participation:	Provides for hearings on reclamation plans with participation by interested parties, provides for citizens' suits against agencies and/or the Secretary of the Interior.
Performance Standards:	Provides detailed performance standards for stabilization, restoration, revegetation, and postmining land use, and prevention of water pollution or off-site effects.
Designation of Lands Unsuitable for Mining:	Provides for protection of prime farmlands and alluvial valley floors, and designation of other lands as unsuitable for mining by interested parties.
Surface Owner Consent:	Requires surface owner written consent, and consultation in development of a comprehensive land-use plan.
Enforcement:	OSM enforces reclamation requirements at existing mines, fines and civil penalties.

reclaim abandoned lands, with states sharing 50 percent of the fee. The Administrator of the EPA must concur with published regulations, and must also concur in approving state programs.[1]

MODIFYING TOPOGRAPHY

There is an opposite extreme to the original contour concept, the leveling of hills and mountains to tabletop flatness. A recent EPA study indicated that mine operators in rough topography generally prefer this approach, questioning the desirability of reestablishing an original contour. The new Strip Mine Act has provisions for making possible use of exceptionally flat tops for airports or parking lots.

--Chironis, Nicholas P. "Imaginative Plans Make Mined Land Better Than Ever." Coal Age, Vol 82 (July 1977), p. 49.

As shown in Table 7-8, many other federal agencies are now involved directly in administering and managing reclamation provisions for energy development. Except for uranium (and other hard rock minerals) this involves a surface management agency that can make stipulations in a lease if the lands are publicly held. These agencies are typically BLM, Forest Service,[2] or the Bureau of Indian Affairs. In the case of coal, extensive and additional requirements have been specified in recently promulgated regulations.

For oil, gas, oil shale, and geothermal resources, most requirements are informal and have developed on the basis of

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[1] EPA has administrative and managerial interest in reclamation particularly in its air, water, and research programs. Mine dust measurements are a part of EPA's air monitoring programs, as is measurement of mine runoff. For example, as of July 1, 1977, coal mines that have discharges are required to comply with Final Effluent Limitations Guidelines promulgated by EPA. Heeman, Michael T. "EPA Sets Water Pollution Limits." Coal Age, Vol. 82 (July 1977), p. 141. Mine runoff, and other surface disturbances from energy development are also supposed to be included in area-wide wastewater management planning. See Federal Water Pollution Control Act Amendments of 1972, Pub. L. 92-500, § 208, 33 U.S.C.A. § 1288 (Supp. 1976).

[2] The Surface Mining Control and Reclamation Act of 1977 (Pub. L. 95-87, 91 Stat. 445) requires the Secretary of Agriculture to demonstrate that adverse effects from surface mining for coal will not occur in national forests; the act does not contain a similar provision for national grasslands. Development is therefore easier on grasslands (which are lands acquired during the 1930's). In addition, fewer revenues from grasslands are distributed locally than are revenues from lands in the public domain, e.g., national forests.

TABLE 7-8: SUMMARY OF RECLAMATION MANAGEMENT PROVISIONS BY RESOURCE

RESOURCE	IMPORTANT STATUTES	AUTHORITY	ADMINISTERING AGENCIES
Coal	Mineral Leasing Act of 1920 and Amendments of 1976	Provides for controlled development and leasing	BLM Forest Service USGS
	Surface Mining Control and Reclamation Act of 1977	Comprehensive requirements and procedures specified in law and codes	OSM States USGS
Oil and Gas	Minerals Leasing Act of 1920	Limited control of leasing Few statutory requirements for reclamation	BLM Forest Service USGS
Geothermal	Geothermal Steam Act of 1970	Provides for controlled leasing Few statutory requirements for reclamation	BLM Forest Service USGS
Oil Shale	Mineral Leasing Act	Provides controlled leasing Few statutory requirements for reclamation	BLM Forest Service
Uranium	Mining Law of 1872	Patents of public lands largely on private initiative	USGS
	Atomic Energy Act of 1954	Few or no controls on reclamation	DOE

BLM = Bureau of Land Management
USGS = U.S. Geological Survey
OSM = Office of Surface Mining Reclamation and Enforcement
DOE = Department of Energy

cooperation between energy company personnel and field agency management staff, whose development-oriented background usually facilitates effective communication with energy company employees.

Specific reclamation requirements for uranium mining are largely nonexistent at both the state and federal levels. Since the early 1970's, environmental groups (especially the Sierra Club and Wilderness Society) have fought to bring land disturbances from uranium development under closer federal control. Interior and Forest Service personnel also favor federal legislation and regulations to ensure that mineral uses on public domain lands are balanced and coordinated with other surface uses. Most of these groups and organizations favor the adoption of a leasing system over the current location-patent system.[1] They contend that uniform federal controls would lead to more production from claims and minimize abuses by claimants who have no intention of mining the claimed lands (see box). Moreover, a leasing system could contain provisions requiring reclamation and assure a "fair return" for "hard rock" minerals extracted from public lands.

UNMINED CLAIMS

In 1974, officials from the General Accounting Office (GAO) visited 240 unpatented mining claims and 93 patented claims selected randomly throughout the U.S. Of the 240 mining claims, GAO found that "239 were not being mined at the time of our visit, and there was no evidence that any mineral extraction had ever taken place on 237 of the claims." The agency reported that only seven of the 93 patented claims were being used for any apparent purpose, while 20 were being utilized for nonmining purposes; for example, for residences or grazing activities. Based on these observations, GAO concluded that the government had "no opportunity to induce mining of these lands" since the 1872 Mining Law does not require that the holder of a claim must mine the land.

--Choitz, Jackie. "Mining Law Update." Colorado/Business, Vol. 5 (February 1978), p. 27.

At least two bills are now before Congressional committee to modify existing controls over uranium mining.[2] One bill, supported by the Carter Administration, calls for a leasing system as noted above. The bill would also impose uniform controls to protect the environmental values of the land. However such changes to the Mining Law of 1872 are being strongly opposed by the American Mining Congress and state mining organizations.[1] Another bill (H.R. 5831) seeks to preserve the present location-patent system, keep the public domain open, and contains no provisions for increased environmental protection, calling for minimal change in the law to limit adverse economic consequences.[2] The contrasting bills underscore the fundamental issues with regard to "hard rock" mineral resources: what actions need to be taken to provide for adequate exploration and development; how much control should the federal government exercise; and what priority should energy development have over other public land uses.

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[1] Choitz, Jackie. "Mining Law Update." Colorado/Business, Vol. 5 (February 1978), pp. 27-28.

[2] See House of Representatives Bills 9292 and 5831. Several committees of the Congress formulate reclamation policies. Two of the most important are the House Interior and Insular Affairs Committee, especially its Subcommittee on Mines and Mining, and the Senate Interior and Insular Affairs Committee and its Subcommittee on Energy and the Environment. The latter has jurisdiction over legislation on environmental impact of the production of energy and energy conservation.

(2) Reclamation and Waste Disposal

Major concerns with mine wastes have generally been over the quality of wastes and the expectation that land used for disposal is irreversibly committed, rather than with "quantities" of land affected. Many mine wastes, especially uranium tailings, solid wastes from coal, and flue gas desulfurization wastes can pose threats to human health and the environment. And because of its volume, spent shale can also pose environmental problems.[3] The seriousness of such threats depends on how the wastes are managed and monitored, including where and how wastes are disposed of or stored and how they are treated and transported.

Governmental regulation of mine wastes typically focus on specific types of wastes or address selected impacts. Two of the more important federal laws relevant to managing the impacts of energy-related waste disposal are the Surface Mining and Reclamation Act (discussed earlier) and the Resource Conservation and Recovery Act of 1976.[4]

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[1] Choitz, Jackie. "Mining Law Update." Colorado/Business, Vol. 5 (February 1978), p. 27.

[2] "Mineral Rights Raise New Dust." Business Week, October 3, 1977, p. 48.

[3] See White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[4] Resource Conservation and Recovery Act of 1976, Pub. L. 94-580, 90 Stat. 2795.

As discussed above, the 1977 Reclamation Act establishes federal control over the surface effects of mining. With regard to wastes, the thrust of the act is to control water pollution. In general, the accompanying regulations require burial of mine wastes. However, the initial regulatory program still deals only with toxic-forming and acid-forming wastes, and with proper reclamation of wastes produced from coal preparation facilities where they are used in backfilling or grading mined areas, placed in impoundments, or used in construction of dams. Complete controls over waste placement, tailings, coal processing wastes, and others are to be addressed later. Sedimentation ponds are included, and inspection by the Mining Enforcement and Safety Administration (MESA) of all settling ponds regardless of embankment heights or volume is required. But the role of MESA regulations once complete controls are developed remains open to question.[1]

The Resource Conservation and Recovery Act provides a framework for dealing with all solid waste disposal. Under this act, land, like air and water resources, is placed under strict federal regulatory control. In attempting to conserve virgin resources, the law seeks to develop a nationwide system for the management of hazardous and solid wastes (regional solid waste plans) and for the recovery of resources from these wastes. If some solid wastes from the coal fuel cycle are classified as hazardous, this could have far reaching effects on the way such wastes are presently handled, and on the final regulations under the Surface Mine Act.

At the present time, regulations dealing with hazardous wastes and regional solid waste plans are still being developed. EPA is charged with establishing criteria for regional and solid waste plans, including mine wastes, and conducting detailed studies of mine wastes. Recognizing the close mandate between reclamation, land use, and EPA's role in maintaining environmental quality, reorganization studies in the Office of Management and Budget have suggested incorporating EPA into the DOI or combining them in a new Department of Natural Resources and the Environment. In part, such a reorganization may be due to the strong environmental approach in Interior by its current Secretary.[2] Some westerners have expressed concern that such a reorganization would "destroy local autonomy, break down communication and cooperation among already existing resource agencies" and could mean decisions affecting western states would be made without sufficient regional representation.[3]

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[1] See 42 Fed. Reg. 62,646 (December 13, 1977).

[2] Kirschten, J. Dicken. "Reorganizing Natural Resources May be Tougher Than Carter Thought." National Journal, Vol. 9 (October 15, 1977), pp. 1613-18.

[3] Sibley, Whit. "Resources Shake-Up Idea Shakes Up Westerners." Denver Post, February 8, 1978.

C. Access to and Control of Recreational and Critical Environmental Areas

The environmental quality of most western states has been stereotyped: New Mexico is "The Land of Enchantment"; Wyoming is "Sportsman's Paradise"; Montana is the "Big Sky" country; and Arizona is a "Retirement Capitol."[1] Yet, these areas are also centers for mining and resource exploitation. Congressmen from the western states are most active in committees that deal with natural resources, and they represent industrial, recreational, and environmental interests that frequently conflict.[2] Providing for wilderness recreational experiences,[3] and for more intensive use of national parks, is a continuing conflict for land managers and policymakers.[4]

As land-use planning has developed during the past decade, so has the government role in controlling individual uses of natural resources such as wildlife, and scenic or recreational areas. These policies are a part of the government activities in planning land use, but they deal more with managing and accommodating the activities of individuals. Many of these controls have been in response to sportsmen and environmental interest group demands to sustain or improve the population status of endangered species and wildlife. Interest groups such as Trout Unlimited, Ducks Unlimited, and the National Wildlife Federation are especially active in the West. The National Wildlife Federation, the Sierra Club, and the National Audubon Society have been historically important groups, and have lobbied for wilderness areas, wildlife areas, wildlife refuges, and controls over endangered species, especially since the 1950's. In response to these lobbying efforts, Congress passed the Endangered Species Acts of 1968 and 1973, the Wilderness Act of 1964, and has added significantly to wildlife refuges in the western states.

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[1] Peirce, Neal R. The Mountain States of America. New York, N.Y.: Norton, 1972, pp. 290-91.

[2] Wagner, James R. "Interior Subcommittees Move Slowly on Legislation to Reform Public Lands Policy." National Journal, Vol. 3 (August 21, 1971), pp. 1768-73.

[3] Wagner, James R. "Agencies Speed Up Review in Push to Expand Wilderness System." National Journal, Vol. 2 (1970), pp. 2826-31; and U.S., President, Office of the White House Press Secretary. "Message to the Congress from the President." Mimeographed copy, Washington, D.C., May 23, 1977.

[4] Scher, Zeke. "The Great Canyonlands Double Cross." Denver Post, Empire Magazine, August 21, 1977, p. 16.

These same groups have been active in promoting increased recreational and scenic resources for tourists and westerners, resulting in legislation[1] establishing the Bureau of Outdoor Recreation (now the Bureau of Heritage Conservation and Recreation) to coordinate recreation planning, and a fund to acquire lands for recreation.[2]

The Bureau is responsible for coordinating Wild and Scenic Rivers, National Trails, and state and local recreation programs. It also coordinates government policy restricting recreational activities such as President Carter's recent Executive Order that establishes federal policy to designate areas in which off-road-vehicles (ORV) can be used and in which they are prohibited.[3] In the latter case, the effect of such a role has been to antagonize a major sector of the recreational public which frequently uses western lands.

The role of a number of federal agencies dealing with wildlife and the quality of the ecosystem is indirect, such as the Soil Conservation Service or the EPA. EPA has a direct research mission in understanding the role of plants and animals in the ecosystem and it regulates air emissions and water quality to minimize adverse effects on wildlife. Russell Train, a past Administrator of EPA, has been critical of agencies in the DOI, suggesting that their guardianship of wildlife resources is too often governed by narrow interests and near-term concerns of income-producing sportsmen.[4] Train cited a Council on Environment Quality estimate that 97 percent of the funds on wildlife management go to three percent of the species, the ones used for hunting, trapping, or fishing.[5]

In the past both individual energy development companies and their lobbies, such as the American Petroleum Institute and the American Mining Congress, have opposed restrictions on vehicle use or setting aside large tracts of land for primitive areas or national parks (see box).[1] These groups have been active in commenting on management proposals such as restrictions on vehicle use that may be important in gaining access to or exploring for energy resources.[2]

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[1] Bureau of Outdoor Recreation Act of May 28, 1963, Pub. L. 88-29, 77 Stat. 49, 16 U.S.C. 460.

[2] Land and Water Conservation Fund Act of 1965, Pub. L. 88-578, 78 Stat. 897, as amended by Federal Water Project Recreation Act, Pub. L. 89-72, 79 Stat. 213.

[3] "Off-Road Vehicles on Public Lands," Executive Order 11989 (May 24, 1977). 42 Fed. Reg. pp. 26959-60 (May 25, 1977).

[4] "Interests Governing Wildlife Too Narrow, Train Says." Environment News. (Boston, Mass.: U.S., Environmental Protection Agency, Region I, New England Regional Office), November 1976.

[5] Ibid.

State government control over recreational activities is diffuse. Programs exist in a number of administrative agencies, including surface management agencies and those involved in managing natural resources. Most states provide for a park and recreation department or commission that manages parks, campgrounds, or recreational areas. A separate department of fish and game typically controls access and catch of game or fish resources, and a state department of forestry controls use of state forests (see Table 7-9).

ACCESS TO RECREATION

There has been considerable opposition to designating lands as national parks. In the case of Canyonlands National Park at the confluence of the Green and Colorado Rivers in Utah, oil, uranium, and other mineral interests as well as stockmen and businessmen opposed creation of the park in the early 1960's. The idea of the park was sold through Park Service films and documents which showed that opening the park to tourists would bring prosperity to Utah residents. In 1977, the National Park Service established the policy that Canyonlands would not be developed for vehicle access, and that it would largely remain a wilderness park. It is now one of the least used national parks, with 79,100 visitors in 1976.

--Scher, Zeke. "The Great Canyonlands Double Cross." Denver Post, Empire Magazine, August 21, 1977, p. 10.

7.2.3 Summary

As the above discussion demonstrates, the land-use impacts of energy resource development occur as a consequence of two kinds of land-use requirements: first, the land requirements of the energy development itself such as for mines, conversion and support facilities, and waste disposal; and second, land required to meet the needs of energy-related population increases, such as housing and recreation. Both kinds of land-use requirements affect competition for public and private lands and environmental quality and aesthetics.

On the basis of the above discussion, land uses can be divided into the three categories shown in Figure 7-2: economic/production, preservation/conservation, and leisure-time/recreation.

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[1] Scher, Zeke. "The Great Canyonlands Double Cross." Denver Post, Empire Magazine, August 21, 1977, p. 10.

[2] U.S., Department of the Interior, Bureau of Outdoor Recreation. Draft Environmental Impact Statement: Departmental Implementation of Executive Order 11644 Pertaining to the Use of Off-Road Vehicles on the Public Lands. Washington, D.C.: Bureau of Outdoor Recreation, July 1976.

TABLE 7-9: STATE RECREATION AND MANAGEMENT AGENCIES

STATE	PARKS	FORESTS	FISH AND GAME
Arizona	Arizona State Parks (Phoenix)	State Land Department (Phoenix)	Game and Fish Department (Phoenix)
Colorado	Division of Parks and Outdoor Recreation, Dept. of Natural Resources (Denver)	Forest Service at Colorado State University (Fort Collins)	Division of Wildlife of Department of Natural Resources (Denver)
New Mexico	Park and Recreation Commission (Sante Fe)	Department of State Forestry (Sante Fe)	Department of Fish and Game (Sante Fe)
Montana	Recreation and Park Division of Department and Fish and Game (Helena)	Forestry Division of Department of Natural Resources and Conservation (Helena)	Fisheries and Game Management Divisions of Department of Fish and Game (Helena)
North Dakota	Department of State Parks and Recreation (Mandan)	State Forest Service (Bottineau)	Game and Fish Department (Bismark)
South Dakota	Department of Wildlife Parks and Forestry (Pierre)	Department of Wildlife Parks and Forestry (Pierre)	Department of Wildlife Parks and Forestry (Pierre)
Utah	Parks and Recreation Division (Salt Lake City)	Department of Forestry and Fire Control (Salt Lake City)	Wildlife Resource Division of Department of Natural Resources (Salt Lake City)
Wyoming	State Recreation Department State Recreation Commission (Cheyenne)	Forestry Division of Department of Environmental Quality (Cheyenne)	Game and Fish Commission (Cheyenne)

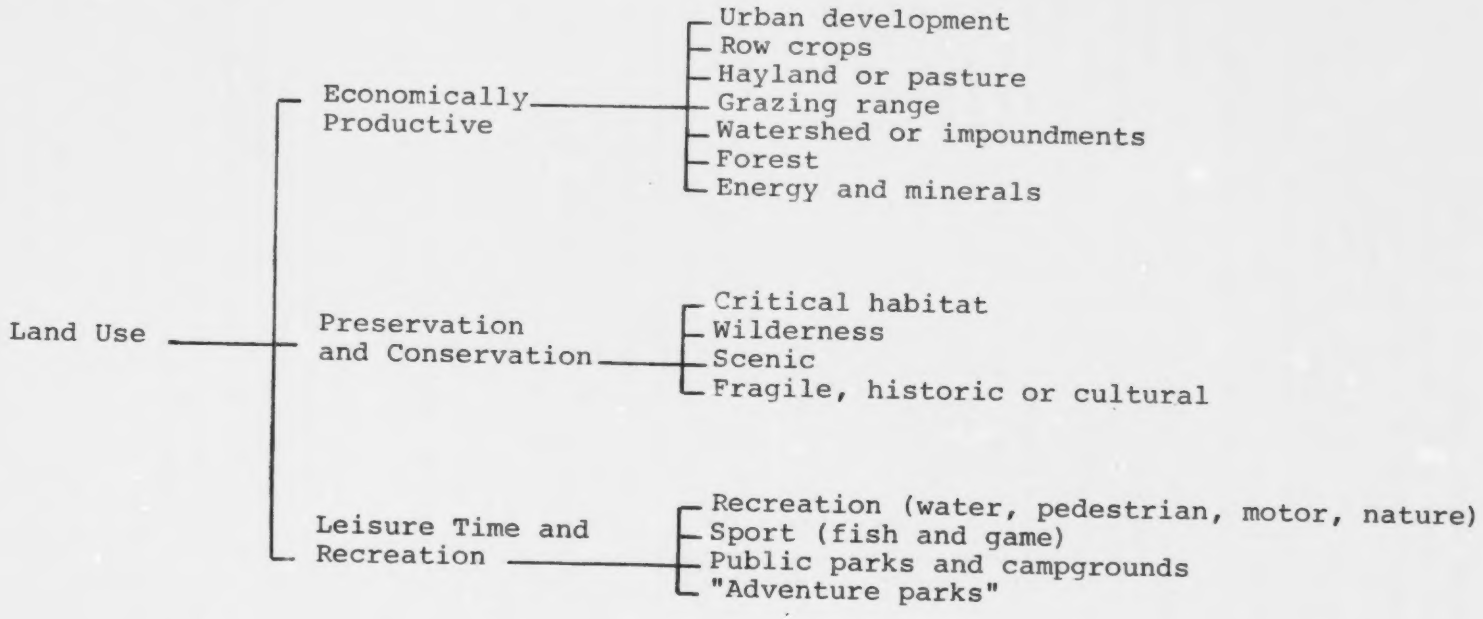
Land Use
Economically Productive
Urban development
Row crops
Hayland or pasture
Grazing range
Watershed or impoundments
Forest
Energy and minerals
Preservation and Conservation
Critical habitat
Wilderness
Scenic
Fragile, historic or cultural
Leisure Time and Recreation
Recreation (water, pedestrian, motor, nature)
Sport (fish and game)
Public parks and campgrounds
"Adventure parks"

FIGURE 7-2: ELEMENTS OF LAND USE DEMAND

Energy resource development must compete for land with other economically productive land uses such as grazing and row crops; and it must compete with preservation and conservation, and leisure-time and recreational uses. Competition already exists within and among these three categories of land use in the West. Large-scale energy resource development and the associated large population increase that can be expected will intensify this competition during the next two decades or so, taxing the conflict resolution and problem-solving capabilities of all levels of government.

The major environmental and aesthetic impacts of energy development will occur as a consequence of surface lands being disturbed, both by the construction and operation of energy facilities and by the leisure-time and recreational activities of an enlarged population. Surface mining, site preparation, road building, and other energy development activities will disturb surface lands, usually in relatively small amounts for any single facility, but in large amounts in areas of concentrated, large-scale development. Whether these lands can be successfully reclaimed and returned to their original or some other economically productive use is still problematic; and, as in dealing with increased competition for land, successfully reclaiming these lands will challenge the planning, monitoring, and enforcement capabilities of all levels of government.

Leisure-time and recreational environmental and aesthetic impacts may be more lasting and may prove to be more difficult to deal with successfully. The increased, easier access needed for energy development will open up more lands for leisure-time and recreational activities. The use of ORV and other vehicles will be greatly increased and, unless adequately controlled, will deface and scar the land. Hunting will also increase, stepping up the pressure on game animals in the vicinity of energy developments. Population encroachments will cause certain species of animals to retreat from their present habitat; and, in some cases, habitat fragmentation and encroachment together with the land disturbed directly by energy development activities may consume a significant proportion of certain types of habitat.

As noted above, all of these land-use and reclamation impacts and problems and issues will challenge the planning, monitoring, and enforcement capabilities of all levels of government. It is not clear that the existing institutional mechanisms described above will be adequate to meet the challenge. This problem is complicated by the fact that the federal government and Indian tribes are major landowners in the eight-state study area. Several federal agencies have a management role and responsibility for these lands, including Indian lands. Coordinated, cooperative planning and management among these several agencies is limited, but the major problem appears to be coordination and cooperation among levels of government. For example, state governments cannot be certain that they will be able to participate and have a decisive role in decisions concerning energy developments within their own boundaries. As the analyses in other chapters in this report demonstrate, this is but one area in which serious intergovernmental problems and issues are being raised in connection with western energy resource development.

Given both the range of interests and values at stake in land use in the West and the pluralistic nature and federal structure of our political system, it is unlikely that any one land use or one level of government will prevail over all others. It is much more likely that some lands will be allocated for all three land-use categories identified earlier in Figure 7-2; and that an effort will be made to insure that land-use policymaking institutions and processes are adequate to deal effectively with both present and future land-use and reclamation problems. It can also be expected that an effort will be made to accommodate the multiplicity of interests and various governments involved. Therefore, the overall public policy problems and issues in this category involve both substantive and procedural concerns: Which lands will be allocated for which use in what quantity? Can lands disturbed by energy development be returned to their original state or to some economically productive state? How and by whom will allocations be made, access and activities controlled, and reclamation insured? In the following section, alternative policies and implementation strategies for dealing with these problems and issues are identified, evaluated, and compared.

7.3 ALTERNATIVE POLICIES FOR LAND USE AND RECLAMATION

7.3.1 Introduction

The above discussion led to the conclusion that land-use and reclamation problems and issues likely to arise as a consequence of western energy resource development reflect two kinds of concerns: procedural and substantive. Procedural concerns focus on how policies are made; for example, on whether state and local governments are given adequate opportunities to protect their interests when decisions about the development of federal lands are made. Substantive concerns focus on the content and anticipated consequences of land-use and reclamation policies; for example, on which lands are to be allocated for surface mining and what the effects of those allocations will be.

Based on the extended discussion in the preceding section, it appears that land-use and reclamation policies relating to western energy resource development must address two closely related, overlapping general policy objectives, one primarily procedural, the other primarily substantive. These two general policy objectives are:

- To insure that the institutions and processes for making land-use and reclamation policies and decisions give adequate consideration to all current and future uses;

- To provide for and protect a diversity of present and future land uses.

7.3.2 Description of Alternatives

To achieve either or both of these objectives, a more comprehensive and better coordinated land-use planning and management system will be required which provides participation opportunities for a broad range of parties-at-interest, coordinates cooperative planning and management among agencies and levels of governments, and specifies what lands can be used for what purposes. Specific alternatives for creating such a system differ primarily in terms of the extent to which the system would be centralized, how comprehensive it would be, and the degree of control over land uses that would be exercised. The possible range of specific alternatives is from establishing a centralized federally coordinated comprehensive land-use planning and management system to incrementally improving the decentralized fragmented system described above; and from making case by case decisions for selected kinds of land uses (such as energy facility siting) to preparing a comprehensive land-use plan which designates permissible land uses and requires all lands disturbed by energy development either to be reclaimed to their predevelopment condition or redeveloped for some productive use.

A. What Are the Alternatives?

It is not feasible to deal here with the entire range of policy alternatives for achieving the two general objectives stated above. The scope of the analysis can be narrowed considerably by focusing on a more specifically western energy objective drawn from the two objectives described in Section 7.3.1:

- To meet the land-use needs of energy development, including the land requirements of energy-related population increases, while providing for and protecting a diversity of present and future land uses.

As shown in Table 7-10, establishing a better coordinated, more comprehensive land-use planning and management system to control land use and changes in land use is one way to go about attempting to achieve this objective. Specifically, to achieve this objective, land use and changes in land use would have to be controlled and all lands disturbed by energy resource development would have to be either reclaimed or redeveloped. The alternatives are not mutually exclusive and a comprehensive land-use

TABLE 7-10: LAND-USE AND RECLAMATION OBJECTIVES AND POLICY ALTERNATIVES

OBJECTIVE	CATEGORY OF ALTERNATIVES	SPECIFIC ALTERNATIVES
Meet the land-use needs of energy resource development, including those associated with population increases, while providing for and protecting a diversity of present and future land uses	Control land use and changes in land use	Designate permissible land uses
		Control access to and activities on all public and private lands
	Require rehabilitation of all lands disturbed by energy resource development	Require reclamation (return to predevelopment use)
		Require redevelopment (return to some other productive use)

planning and management system would probably include both.[1] Each alternative could be designed to achieve the stated objective of supporting energy development while providing for and protecting a diversity of present and future uses. The two alternatives differ primarily in terms of emphasis.

B. How Can the Alternatives Be Implemented?

The first category of alternatives emphasizes a comprehensive planning approach which attempts to insure "appropriate" or "best" fit of land and land-use activities (see Chapter 12 on Energy Facility Siting). Based on an understanding of present and future land needs and the compatibility of specific land areas and land uses, permissible land uses for these land areas would be identified. This means, of course, that certain land uses may be explicitly prohibited; for example, surface mining on prime agricultural lands. And it may be considered desirable to control access to and activities in designated permissible use areas. For example, the number of people allowed in a recreation area at any one time may be limited; and snowmobiles may be permitted but not other kinds of ORV's.

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[1] Terminology in this problem area is not standardized. As used here, rehabilitation means that disturbed lands will be restored to some productive use; reclamation means restoring to the predevelopment use; redevelopment means restoring to some other productive use.

This comprehensive planning approach could be centralized with the federal government formulating the goals and the states implementing them. (This is the pattern in water and air quality, see Chapters 5 and 6.) Or the federal role could be limited to providing financial and technical assistance. However, because of the large amount of federal land in the West, it is unlikely that a state system could deal effectively with the land-use problems and issues discussed earlier unless the federal government were to cooperate with the states to coordinate planning for federal lands with state planning for state and private lands. An intermediate alternative that would address this federal-state problem, would be to establish a multistate land-use planning organization as a forum for cooperative, coordinated land-use planning and management in the region.

The second category of alternatives emphasizes returning lands disturbed by energy resource development to a productive use. Within the current land-use and management system, lands would be made available to meet energy needs with the stipulation that they be rehabilitated. Specific alternatives would be to require either reclamation or redevelopment. As with the first category of alternatives, this approach could give the lead planning and management role to the federal government, to the states, or to a multistate organization.

In the following section, only reclamation and redevelopment alternatives are evaluated and compared. This narrower focus is necessary because of the scope of this topic, but it also seems appropriate because of the importance of the reclamation issue for western energy resources development.

7.3.3 Evaluation of Alternatives

In general, energy resource development can be viewed as a temporary or "interim" land use. With some possible exceptions, lands withdrawn for energy resource development will be available for other uses after development is completed. The basic question is whether these lands will be returned to their predevelopment use or to some other productive use. That is, will they be reclaimed so they can be used as they were before energy development, or redeveloped so they can be used for some other productive use. Current state and federal laws and regulations generally require that lands disturbed by surface mining be reclaimed.[1] In the West, this usually means returning them to an agricultural use.

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[1] Comparable requirements have not been established for other surface-mined resources such as oil shale and uranium.

Current regulations permit some variation in meeting these objectives depending on site-specific conditions. However, the clear preference articulated in both state and federal requirements is for reclamation rather than redevelopment. It is not obvious that this is always the "best" policy alternative; and it is not clear that reclamation is possible in all parts of the West. What follows is an analysis of the reclamation and redevelopment alternatives. To the extent possible given the limited information available, these two alternatives are evaluated and compared. Information is limited in large part because experience in the West with both reclamation and redevelopment is limited.

A. Evaluation Criteria

The five basic evaluation criteria identified and defined in Chapter 3 will be used in this analysis: definitions of these criteria as they apply to reclamation and redevelopment are presented in Table 7-11 together with appropriate quantitative and qualitative measures. As Table 7-11 illustrates, applying these criteria raises both substantive and procedural questions. Although there is some overlap, questions about achieving objectives, costs, risks, and benefits and the distribution of costs, risks, and benefits are primarily substantive while questions about flexibility and implementability are primarily procedural. This is appropriate since, as noted above, the overall policy objectives for land use and reclamation are also substantive and procedural.

B. Evaluation of the Reclamation Alternative

Almost all energy resource development in the eight-state study area will take place in rural settings where the most common current land uses are agricultural, primarily ranching, grazing, and farming. As noted earlier, reclamation in this setting means returning the lands disturbed by energy development to these predevelopment agricultural uses. Two strategies for implementing this alternative are identified in Table 7-12: continue current requirements or make the system more flexible. As the evaluation in this section will show, the major reasons for considering an alternative to the current requirements is that their dollar costs are generally high and the probability of successful reclamation in all parts of the study area is uncertain.

At the present time, reclaiming surface-mined coal lands goes on simultaneously with mining and, in this area, usually involves backfilling, grading, replacing topsoil (which is now often separated and stockpiled during mining), and establishing a vegetation cover. Revegetating requires soil preparation, seeding and/or planting, and perhaps fertilizing and irrigating. At most western mine sites, seeding can be accomplished by either broadcasting or drilling. If trees and shrubs are planted, they are usually planted by hand.

TABLE 7-11: EVALUATION CRITERIA AND MEASURES FOR RECLAMATION AND REHABILITATION

CRITERIA	APPLIED TO LAND USE	MEASURES
Effectiveness Achievement of substantive policy objectives?	Does the alternative provide for multiple uses and protect future productive uses of the land? Does the alternative reduce the potential irreversibility of mining decisions? Will the land be returned to postmining productive use without unreasonable delay?	Quantitative Success in returning land to its "highest and best" use: standards vary according to site-specific considerations (potential value of land after development compared to preexisting value; loss of income damages incurred). Length of time required to return land to post-mining use. Extent to which all disturbed lands are covered.
		Qualitative Compatibility with adjacent and surrounding land use and existing governmental plans and policies. Degree to which alternative constrains energy development.
Efficiency Costs, risks, and benefits?	Does the alternative provide for reclamation of land to its "highest and best" use in an economic sense? What technical and political uncertainties must be resolved? Will the alternative avoid or mitigate "externalities" associated with the use of land for energy and minerals development?	Quantitative Economic costs, risks, and benefits: direct cost of alternative; estimates of direct benefits and risks. Cost-effectiveness and opportunity costs.
		Qualitative Environmental costs. Technical and political risks: experience in application; adverse effects on government and public; uncertainty. Social costs, risks, and benefits, (e.g., aesthetics).

TABLE 7-11: (Continued)

CRITERIA	APPLIED TO LAND USE	MEASURES
Equity Distribution of costs and benefits?	Who bears the economic and social costs of the alternative? Is the burden associated with the alternative distributed in a fair manner?	Qualitative and Quantitative Distribution of costs, risks, and benefits among political jurisdictions, economic sectors, groups, and individuals.
Flexibility Adaptability to different locational needs and changes over time?	Does the alternative allow for site-specific differences in land-use needs and reclamation/rehabilitation requirements as compared to uniform standards and regulations? Can the alternative accommodate changes which might occur in land-use needs over time?	Qualitative Degree to which land-use planning institutions and processes allow for site-specific differences. Adjustability of the alternatives (adjustments to meet changing conditions).
Implementability Possibility of being adopted/accepted?	How much does the alternative challenge traditional attitudes about land use? How much does the policy challenge institutional relationships? Does the policy reduce conflict among the various users of land?	Quantitative Dollar cost of administration. Qualitative Ease of administration. Adequacy of information.

TABLE 7-12: IMPLEMENTATION STRATEGIES AND CONSTRAINTS FOR RECLAMATION

SPECIFIC ALTERNATIVE	IMPLEMENTATION STRATEGIES	CONSTRAINTS
Require all lands disturbed by energy resource development to be reclaimed (returned to their predevelopment use).	Continue to require regrading to original or approximately original contour, replacement of topsoil, and, with some exceptions, revegetation with "native" species.	Probability of success is uncertain and economic costs to developer are high.
	Change existing state and federal laws and regulations to set reclamation goals and require the states to establish implementation programs which set specific requirements on the basis of site-specific conditions.	A more flexible system would be more difficult to administer and the total economic costs may be as high or higher than they are under the present system.
		A more flexible system will not necessarily insure a higher probability of reclamation success.

A wide variety of seeds, shrubs, and trees are being used. Native seeds and seedlings are usually required unless it can be shown that an "introduced" species will have "equal or superior utility for the approved postmining land use, or are necessary to achieve a quick, temporary, and stabilizing cover."[1] However, no concensus exists among state reclamation authorities and mining companies as to which varieties are preferable. Sweet clover, crested wheatgrass, smooth broomgrass, and alfalfa are relatively quick and easy to get started; and cattle do well on these varieties. However, there is some question about their long-term survival and, in some instances, state authorities have refused to release the reclamation bonds of coal companies which have used only these varieties in their reclamation program.[2] Most of the states in the study area now call for the use of native seeds to produce a native vegetation cover even though it takes longer to establish.

As shown in Table 7-11, five criteria can be used to evaluate the reclamation alternative. These five criteria raise five basic questions: How effective will reclamation be? What costs, risks, and benefits does it involve? How will these costs, risks, and benefits be distributed? Can the alternative be used at a variety of sites under a range of conditions? And, how difficult will the alternative be to implement?

(1) How Effective Will Reclamation Be?

The effectiveness of reclamation can be evaluated in terms of: What is the probability of success? How long will the disturbed lands be withdrawn from productive agricultural uses? How compatible will agricultural uses of the reclaimed lands be with other land uses and environmental plans and programs in the area? And, to what extent will reclamation requirements constrain energy resource development?

As noted earlier, current practice is for reclamation to be an integral part of the mining activity itself. The time required to return surface-mined lands to productive uses depends on site-specific factors such as climate and soil characteristics. Long-term success in reclaiming land, especially in arid and semiarid areas, is uncertain, but will depend largely on the management commitment made by the landowners and/or the mining company, including controlling grazing and other potentially damaging activities.[1]

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[1] 42 Fed. Reg. 62691 (December 13, 1977).

[2] Thoem, Terry, Environmental Protection Agency, Region VIII. Personal Communication.

Assuming success in reclaiming to predevelopment agricultural uses, some lands will be withdrawn from use from the time of the initiation of mining site preparation until some five to seven years after the mining operation is terminated. However, because reclamation and mining go on simultaneously, blocks of land would be returned to productive agricultural uses thoughout the lifetime of the mine.

In terms of the other measures of effectiveness in achieving land-use objectives, reclamation ranks high on compatibility with other land uses, particularly if the implementation strategy is designed to meet current requirements with regard to contours and seeding. However, unless proper preventive steps are taken, reclaimed lands can be a nonpoint source of water pollutants, particularly if fertilizers are used and if erosion and leaching occur. Sedimentation in local streams can also be a problem. And the reclaimed area is a potential source of particulates that can contribute to air quality problems. If these kinds of problems are not controlled, reclamation may well conflict with environmental plans and programs in the area.

(2) What Costs, Risks, and Benefits Are Involved in Reclamation?

Economic costs and benefits are an important measure of the efficiency of reclamation. Clearly the economic costs of regrading and revegetation alternatives are high. As shown in Table 7-13, these costs vary from site to site. Currently, predictions of reclamation costs are uncertain. In part, this is because of differences in the accounting procedures used by mining companies to calculate reclamation and related costs. In part it is because many locational factors cause costs to vary from one site to another. These factors include such things as terrain, soil, vegetation, type and thickness of overburden, seam thickness, ground and surface water, climate, type and size of equipment used, mining technique, applicable reclamation laws and regulations, and the mining companies' land reclamation methods.[2] On the basis of published reports, the range for total reclamation costs in the

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[1] See Hodder, Richard L. "Surface Mined Land Reclamation Research in Eastern Montana," in National Coal Association. Papers Presented Before Research and Applied Technology Symposium on Mined-Land Reclamation. Monroeville, Pa.: Bituminous Coal Research, Inc., 1973, p. 85.

[2] U.S., Department of the Interior, Bureau of Mines. Coal Surface Mining Reclamation Costs in the Western United States. Washington, D.C.: Government Printing Office, 1977, p. 6.

TABLE 7-13: ESTIMATES OF RECLAMATION COSTS IN THE WEST, 1977

COST ITEM	HIGH DESERT AREA (Sites 1 & 2)[a]	MOUNTAIN AREA SITE[b]	NORTHERN GREAT PLAINS		
			SITE 1[c]	SITE 2[d]	SITE 3[e]
Design, engineering and overhead:[f]					
Range, per acre	$480-1,070	$650-750	$350-730	$350-650	$200-400
Range, per ton	0.04-0.06	0.06-0.08	0.01-0.02	0.04-0.07	<0.01-0.01
Bond and permit fees[g]					
Range, per acre	0-80	25-45	50-70	20-40	60-100
Range, per ton	0.0-<0.01	<0.01-<0.01	<0.01-<0.01	<0.01-<0.01	<0.01-<0.01
Backfilling and grading:[h]					
Range, per acre	1,250[i]-3,420	990-1,970	3,700-6,200	2,200-5,500	1,800-2,900
Range, per ton	0.08[i]-0.18	0.10-0.20	0.12-0.20	0.24-0.61	0.05-0.09
Revegetation:[j]					
Range, per acre	110-470	30-45	100-200	100-150	140-200
Range, per ton	0.01-0.02	<0.01-<0.01	<0.01-<0.01	0.01-0.02	<0.01-<0.01
Total reclamation:					
Range, per acre	1,840-5,040	1,670-2.810	4,200-7.200	2,670-6,340	2,200-3,600
Range, per ton	0.12-0.26	0.16-0.28	0.13-0.23	0.29-0.70	0.06-0.10

< = less than

Source: Adapted from U.S., Department of the Interior, Bureau of Mines. *Coal Surface Mining Reclamation Costs in the Western United States*. Washington, D.C.: Government Printing Office, 1977, p. 7.

[a] Sites 1 and 2 were selected from five surface mines operating in the Four Corners area of Arizona and New Mexico.

[b] Site is representative of four low-sulfur bituminous coal operations in Yampa coal field, Routt County, Colorado.

[c] Site 1 is a single bed area stripping operation like those in Montana and Wyoming (25 foot seam),

[d] Site 2 is an area strip mine producing lignite (North Dakota).

[e] Site 3, an area stripping operation like those in Montana and Wyoming (40 foot seam).

[f] Includes reclamation plan development, preparation of periodic environmental reports, supervision of reclamation work, engineering and surveying for environmental protection, water quality protection and monitoring, overhead of environmental activities, outside environmental consultants, some surveying and mapping, dust control associated with reclamation, miscellaneous expense.

[g] Estimated using annual charge divided by the number of acres disturbed each year.

[h] Includes removal of vegetative cover where topsoil must be salvaged, removing and stockpiling topsoil, backfilling troughs, ramps, and final cuts, rough and fine grading of spoil, replacing topsoil.

[i] Where available topsoil is removed and replaced, which more than doubles costs for backfilling and regrading compared to areas with no topsoil.

[j] Soil preparation, seeding and/or planting, reseeding and/or replanting if required, and irrigation.

West appears to be from less than $1,000 per acre to $6,000 or $7,000 per acre (see Table 7-13).

The Surface Mining Act of 1977 is expected to add to these costs since it requires more extensive and detailed surveys and monitoring as part of the requirement for obtaining a lease or permit. For example, the act requires monitoring climate and air quality, and a detailed survey of previous and current land use and soil and water characteristics, as well as improved sedimentation control. However, an analysis of the potential energy and economic impacts of the Surface Mining Act as proposed in 1976 suggests that the cost impacts associated with the new legislation will not be great.[1] The report does point out that several provisions with regard to alluvial valley floors and other lands declared unsuitable for mining are subject to varying interpretations. However, strict interpretation of these provisions will affect production more than cost.[2]

If an evaluation of the economic costs of reclamation is to be meaningful, these costs must be weighed against the potential return to the energy developer, landowner, and the public-at-large. In other words, the question in monetary terms is: Can the investment be justified in cost-effective terms? Based on cost estimates representing the range of land areas likely to be disturbed and average reclamation costs, reclamation of western surface mined lands can require an investment of from $600 million to $5 billion (1976 dollars). Although additional work is needed to quantify this (to the extent that it can be quantified), it has not been generally shown that reclamation is cost-effective.[3]

Efficiency considerations also include an evaluation of the social benefits gained (or costs deferred) as well as dollar costs incurred by developers. Since current laws and regulations require reclamation, they imply that as a society, we are willing to pay the price for land restoration (e.g., in higher energy prices and higher costs for administering reclamation programs) and/or are unwilling to accept the social costs associated with "sacrificed" or abandoned lands.

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[1] ICF, Inc. Energy and Economic Impacts of H.R. 13950 (Surface Mining Control and Reclamation Act of 1976, 94th Congress), Draft Final Report. Washington, D.C.: ICF, Inc., 1977, p. 2.

[2] Ibid.

[3] For example, see LaFevers, James T., Donald O. Johnson, and Anthony J. Dvorak. Extraction of North Dakota Lignite: Environmental and Reclamation Issues. Argonne, Ill.: Argonne National Laboratory, 1976, p. 177.

Recontour-revegetation alternatives appear to be highly efficient in mitigating indirect impacts, such as those of an aesthetic nature.[1] These alternatives include maintaining the natural topography of the landscape and protecting farmlands and other agricultural lands.

Environmental or social costs are more difficult to deal with. For example, regrading and soil compaction may cause higher erosion rates which will result in increased stream sedimentation and some loss of agricultural productivity. Other direct impacts may stem from the intensive use of fertilizer to stimulate rapid revegetation. Over the long term, the extensive use of fertilizer may have an adverse cumulative effect on surrounding or adjacent lands,[2] but it is often needed to reestablish vegetation. It does seem, however, that these impacts are primarily short-term trade-offs which are required if sites are to be returned to their previous use.[3] For example, if revegetation is rapid, fertilizer runoff will be a short-term problem.

Longer-term trade-offs that affect the efficiency of reclamation decisions are foregone opportunity costs, such as the loss of public and private benefits that might be gained from the land if it were returned to some other use. For example, marginal agricultural lands in some western states may be of such low economic value that the several thousand dollars per acre investment needed to return the land to its former use cannot be justified on the basis of economic efficiency alone.

(3) How Will These Costs, Risks, and Benefits Be Distributed?

Overall, reclamation costs will result in increased coal prices. Long-term contracts for western coal now set a per ton at-the-mine price of between \$2.50 and \$7.50.[4] If reclamation costs are between 12 and 70 cents per ton, reclamation costs will range from 2 to 28 percent of the price of coal. In terms of equity, the distribution of these costs can be an important factor influencing the profit margin of a mining company. In the short term, most of these costs are borne almost exclusively by developers. And where the landowner is someone other than the energy company, the benefits of the investment go largely to the owner. As shown above, reclamation costs may often exceed what is considered to be the potential value of the land after restoration, thus raising an equity issue. Mining companies may believe they are being asked to bear an unreasonable share of the financial costs. Of course, in the long term, these costs will be passed on to the energy consumer. If reclamation becomes too costly, monetarily, it could eventually constrain production at some locations, or could increase demands by developers for financial assistance. In sum, however, the basic equity question is whether it is fair for future generations to be left with unreclaimed mined lands. As addressed by the 1977 Reclamation Act, the public policy response has been to define this as an unacceptable alternative.

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[1] King, David A. "Recreational Opportunity Costs," in Thames, John L., ed. Reclamation and Use of Disturbed Land in the Southwest. Tuscon, Ariz.: University of Arizona Press, 1977, p. 174.

[2] LaFevers, James R., Donald O. Johnson, and Anthony J. Dvorak. Extraction of North Dakota Lignite: Environmental and Reclamation Issues. Argonne, Ill.: Argonne National Laboratory, 1976, pp. 175-76.

[3] Ibid.

[4] Asbury, J.G., H.T. Kim, and A. Kouvalis. Survey of Electric Utility Demand for Western Coal. Argonne, Ill.: Argonne National Laboratory, 1977, pp. 45-61.

Cost-effectiveness issues and equity considerations concerning who bears the reclamation burden may be two reasons why industry has been willing to accept uniform reclamation standards. Although this often entails the acceptance of somewhat arbitrary criteria for land rehabilitation, regrading peaks and ridges to the original or approximate contour and revegetation to an extent at least equal to natural cover is generally preferred by mine operators.[1]

(4) Can Reclamation Be Used at a Variety of Sites Under a Range of Conditions?

Decisions concerning reclamation are generally negotiated among the surface owner, energy company, and the state reclamation authorities before development begins. Depending on the discretionary authority granted the state agency, these decisions may or may not accommodate site-specific factors.[2] As a rule, the more specific the state requirements in terms of criteria, the less flexible they are. However, the reclamation alternative does keep many other land-use options open should adjacent or surrounding uses change. This is in contrast to development for residential uses, industrial uses, and other redevelopment options which are generally less reversible.

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[1] Chironis, Nicholas P. "Imaginative Plans Make Mined Land Better Than Ever." Coal Age, Vol. 82 (July 1977), p. 48.

[2] In August 1976 Colorado's Mined Land Reclamation Board was confronted with the question of how much discretion should be given to its staff to approve changes in reclamation plans once the Board has issued a permit. Colorado's 1976 law appears to require public hearings for any change in mining plans, but the agency seemed to be pushing for authority to make changes so that mining companies would not be inconvenienced by delays. See Wynkoop, Steve. "Reclamation Board Ponders Authority." Denver Post, August 20, 1976.

(5) How Difficult Will It Be to Implement Reclamation?

The reclamation alternative should be straightforward and easy to implement. Reclamation appears to be preferred by both developers and environmentalists. The uniformity of requirements for reclamation should make administration easy if the rules are closely followed. Costs of administration are likely to be low but will increase if the time period is very long, if success is elusive, and/or if administration becomes more flexible.

The results of this evaluation of the reclamation alternative are summarized in Table 7-14. Briefly, what the table shows is that reclamation may not be successful, will take at least five to seven years to accomplish if it is successful, is expensive, has not been demonstrated to be cost-effective, and may not return the land to its most productive use. The major beneficiaries of reclamation will be future generations and landowners. Current requirements do not cover oil shale and uranium surface mining and do not adequately accommodate site-specific differences between coal mines. The table also shows that reclamation is generally the rehabilitation option preferred by both developers and environmentalists.

C. Evaluation of Redevelopment Alternative

As noted earlier, in addition to the alternative of returning disturbed lands to their predevelopment use, they can be redeveloped for some other productive use such as residential subdivisions, new towns, industrial parks, wildlife refuges, public parks, and waste disposal facilities, among others. Table 7-15 shows that two general implementation strategies can be followed: the first is to change current state and federal laws and regulations and require approval of a redevelopment plan similar to the current reclamation plan; and the second is to include plans for redevelopment when land-use plans are prepared, including specifying which redevelopment uses are preferred.

Because of the pressures that energy-related population growth will place on outdoor recreational facilities, redevelopment for recreational use is given special attention here. Since experience with the redevelopment alternative has been limited in the West, information for a detailed evaluation of this option is not available. As a result, this evaluation is based on generalizations from the experience with several redevelopment efforts in other parts of the country.

TABLE 7-14: A SUMMARY EVALUATION OF THE RECLAMATION ALTERNATIVE

CRITERIA	MEASURES	FINDINGS
Effectiveness How effective will reclamation be in returning lands disturbed by energy development to their predevelopment agricultural uses?	Probability of success	Success is uncertain, particularly in arid and semiarid areas.
	Duration of withdrawal	If successfully reclaimed, lands will be out of production for at least 5 to 7 years. However, the amount of land out of production at any one time is minimized since reclamation and mining proceed simultaneously.
	Compatibility	Since disturbed lands are being returned to their predevelopment agricultural use, compatibility with other land uses in the area should be high. Compatibility with environmental policies and programs is not assured since reclaimed lands can be a source of air and water pollutants.
	Coverage	Current laws and regulations deal only with surface coal mining. Oil shale and uranium mining are not covered.
	Degree of constraint	High dollar and economic costs in some areas could eventually constrain development.
Efficiency What will be the costs, risks, and benefits associated with reclamation?	Economic costs and benefits	The economic cost to developers will be high, a per acre cost ranging from slightly less than $1,000 to $7,000. Assuming a coal price under current long-term contracts of $2.50 to $7.80 per ton, and a reclamation cost of 15 to 40 cents per ton, reclamation could increase the price of coal by 2 to 16 percent. Benefits: the land will be returned to a productive use; there should be increased employment and a product to sell.
	Cost-effectiveness	The economic and social cost-effectiveness of reclamation has yet to be established. Since reclamation is both uncertain and may not return the land to its most productive use, there can be opportunity costs (foregone economic and social benefits and opportunities).
	Risks	The land-use impacts of energy resource development may be irreversible. The economic risk depends on the market for the agricultural product produced.
	Environmental costs and benefits	Since lands are returned to their original contour, aesthetic impacts will be temporary if reclamation is successful. Air (particulates) and water quality (runoff and sedimentation) problems will also be temporary if reclamation is successful.

TABLE 7-14: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity How will these costs, risks, and benefits be distributed?	Costs	Developers and, ultimately, consumers will bear the economic costs of reclamation. In some locations, for example, where long-term irrigation will be required, the cost to the developer will be especially high and may not be recoverable.
	Risks	Overall, future generations face the greatest risk because of uncertain reclamation success. During development and immediately after reclamation efforts begin, the developer will bear the greatest risk, including the possibility of forfeiting the reclamation bond.
	Benefits	In the long term, future generations stand to benefit most since the greatest range of options for land uses will be preserved. In a more immediate sense, it is the landowner and society at large who are the major beneficiaries.
Flexibility Is the alternative sufficiently flexible to be applicable under a variety of conditions and over time?	Adaptability	Current requirements do not generally accommodate site-specific differences. There appear to be few opportunities for discretionary decisions by reclamation authorities, including adapting to land-use changes in the surrounding areas.
	Adjustability	There appears to be no provision for adjusting to some other rehabilitation objective if reclamation appears to be failing or if costs become excessive.
Implementability How difficult will it be to implement the alternative?	Acceptability	Reclamation can reduce but not eliminate energy-environmental conflict. It can also help to reduce western concerns about bearing the costs of producing energy for other regions. This alternative appears to be preferred by both developers and environmentalists.
	Ease of administration	Uniformity of requirements makes administration easy if the rules are rigidly adhered to. Dealing with exceptions such as when nonnative seeds may be used may be difficult.
	Cost of administration	Costs of administration appear to be relatively low. However, due to the time period required and the uncertainty of success, costs may escalate. The more flexible the administration, the higher administrative costs are likely to be.
	Adequacy of information	There is no previous experience, and information for administering the program is generally inadequate.

TABLE 7-15: IMPLEMENTATION STRATEGIES AND CONSTRAINTS FOR REDEVELOPMENT

SPECIFIC ALTERNATIVE	IMPLEMENTATION STRATEGIES	CONSTRAINTS
Require all lands disturbed by energy resource development to be redeveloped (returned to some productive use other than their predevelopment use).	Change existing state and federal laws and requirements to permit redevelopment for compatible productive uses other than reclamation; require redevelopment plans to be approved by state and federal authorities.	Reduces range of options for future land uses.
		Increases possibilities of incompatible land uses.
	Include specifications of redevelopment uses in county or area-wide plans, designating where specific redevelopment uses are permitted, encouraged, or prohibited.	There may be no demand for "appropriate" redevelopment land uses.
		The alternative use, e.g., for recreation, may remove the land from the tax rolls.

Federal agencies (especially the Bureau of Mines),[1] development companies, and mining companies[2] are actively investigating alternative concepts for redeveloping energy resource lands. Most of their studies are based on actual demonstration projects to redevelop "abandoned" lands where strip, open-pit, or underground mining occurred sometime in the recent past; and they provide useful information for policymakers who wish to consider a productive land use other than reclamation. As noted in one of these studies, "Possible uses for surface-mined lands have been scarcely 'scratched.'"[3]

One of the redevelopment alternatives which has been discussed in a number of studies[4] is the establishment of public parks with recreational facilities as postmining land-use options. In general, redevelopment of energy lands for use as public parks with recreational facilities takes place in several sequential stages: planning; site preparation; and additional project work. The planning phase is critical because it involves the cooperation and assistance of numerous parties-at-interest. For example, in a project to develop a state park on 117 acres of abandoned lands conducted in Butler County, Pennsylvania, the Bureau of Mines, several agencies of the state of Pennsylvania, the county, and private contractors were involved in the project.[5] Where resource development has not yet begun, the planning phase would undoubtedly include input from citizens and local governments to assist in determining the need for and type of second use for the disturbed lands. Cooperative agreements must be worked out between federal and state agencies where the land is owned by the federal government, and similar ownership arrangements must be made between state and/or county governments to acquire lands held in private ownership. Friendship Park, a multiple recreational use facility in Jefferson County, Ohio, was developed on 1,100 acres of strip-mined land donated to the County by Hanna Coal Company (a division of Consolidated Coal) of Cadiz, Ohio.[1]

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[1] Fowler, Dale K., and Charles H. Perry III. "Three Years Development of a Public Use Wildlife Area on a Mountain Coal Surface Mine in Southwest Virginia," in Bituminous Coal Research, Inc., ed. Research and Applied Technology Symposium on Mined-Land Reclamation. Monroeville, Pa.: Bituminous Coal Research, Inc., 1973, p. 319.

[2] For examples, see Camin, Kathleen O., et al. Mined-Land Redevelopment. Lawrence, Kan.: University of Kansas, State Geological Survey, 1972; National Academy of Sciences. Rehabilitation Potential of Western Coal Lands. Cambridge, Mass.: Ballinger Publishing Co., 1974; Carter, Ralph P., et al. Surface Mined Land in the Midwest: A Regional Perspective for Reclamation Planning. Springfield, Va.: National Technical Information Service, 1974; and Matter, Fred S., et al. A Balanced Approach to Resource Extraction and Creative Land Development. Tuscon, Ariz.: University of Arizona, College of Architecture and College of Mines, 1974.

[3] See, for example, Andreuzzi, Frank C. Reclaiming Strip-Mined Land for Recreational Use in Lackawanna County, Pa.: A Demonstration Project. Washington, D.C.: U.S., Department of the Interior, Bureau of Mines, 1976.

[4] For example, see "Concept of Mining as 'Interim Land Use' Keys Amax's Coal Policies." Coal Age, Vol. 79 (October 1974), pp. 131-38.

[5] McNay, Lewis M. Surface Mine Reclamation, Moraine State Park, Pennsylvania. Washington, D.C.: U.S., Department of the Interior, Bureau of Mines, 1970.

In addition to planning requirements and acquiring the land, state and federal reclamation laws and regulations must be followed. For example, regardless of the postmining land use, minimum recontour and revegetation requirements have to be met (where applicable), or variances obtained. As noted earlier, in the reclamation discussion, states generally prefer reclamation to predevelopment uses, thus, efforts to create a new second use may require even closer cooperation among all participants to ensure adherence to reclamation standards.

Finally, the planning phase includes activities to identify funds available from both public and private sector sources. In the Appalachian region, the Regional Commission has in the past been a major financial source for states and counties interested in pursuing redevelopment options. Support has also come from agencies of the federal government with substantive programs related to the redevelopment alternative chosen, for example, from the Bureau of Outdoor Recreation to develop picnic areas, from the Corps of Engineers to develop reservoirs.

Site preparation is not easily generalized, largely because it depends on numerous locational factors; for example, the type of energy resource development which disturbs the land, the intended redevelopment use, geography of the area, and climate. However, work accomplished in this phase typically entails backfilling, grading and terracing, compacting, reapplication of topsoils, and construction of parking lots, reservoirs or ponds, and secondary roads. Except where variances are obtained, restored areas will have to be compacted and graded to conform and blend with the surrounding areas. Soil characteristics of an area determine the kind of preparation needed if lakes or ponds are to be included in the park. Topsoil requirements and topsoil amendments will also vary depending on the particular activity.[1] Land development companies and state and mining company reclamation officials need to cooperate closely in this phase to ensure that activities which can be incorporated into the ongoing mining plan are carried out simultaneously with energy development.

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[1] Zande, Richard D. "Friendship Park: One Use of Reclaimed Strip Mine Land," in Bituminous Coal Research, Inc., ed. Research and Applied Technology Symposium on Mined-Land Reclamation. Monroeville, Pa.: Bituminous Coal Research, Inc., 1973, p. 294.

Additional project work represents the last step in the redevelopment activity. Site preparation is completed by revegetating open areas that were not previously stabilized, planting trees where required, and constructing park and recreational facilities. Facilities and attractions to make a public park operational have typically been provided by government agencies. These have included park facilities for outdoor recreational activities, picnic grounds, children's play areas, overnight camping facilities, and even museums. Indeed, a major attraction at Keyser Park, developed on strip-mined land in Lackawanna County, Pennsylvania, is the Anthracite Museum constructed by the Pennsylvania Historical and Museum Commission. This Museum presents a comprehensive description of anthracite from the mine to the consumer. Besides the 27,000 square feet of exhibit area, facilities include an auditorium, library, conference rooms, and staff offices.

The need to consider the public parks redevelopment alternative for some sites in the West appears justified given the anticipated pressure of energy-related population on recreational facilities in the region. This is particularly the case where energy development is taking place, or projected to occur, close to growing rural communities where few parks or related amenities presently exist. Of course, the costs and benefits of this alternative must ultimately be weighed against other types of reclamation and redevelopment.

(1) How Effective Will Redevelopment Be?

The effectiveness of redeveloping some lands to public parks with receational facilities can be evaluated in terms of: the probability of success; the time lands will be out of productive uses; compatibility with existing surrounding land uses; and the extent to which the redevelopment alternative might constrain western energy resource development. A primary reason for considering site-specific redevelopment is that the probability of success is high and the time out of productive use appears to be minimized. For example, Keyser Park (Pennsylvania) required three years to redevelop 125 acres of abandoned strip-mine land. This was viewed as an "extended period," necessary to allow for seeding, planting, and seasonal construction. The implication is that this time could be shortened if redevelopment took place simultaneously with extraction processes. That is, site preparation activities could proceed as in the case of reclamation so that minimal seeding and planting would be required prior to actual construction and development of facilities.[1]

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[1] Andreuzzi, Frank C. Reclaiming Strip-Mined Land for Recreational Use in Lackawanna County, Pa.: A Demonstration Project. Washington, D.C.: U.S., Department of the Interior, Bureau of Mines, 1976, pp. 9-14.

Redevelopment alternatives, however, may be constrained by recent federal regulations regarding postmining uses. These regulations require that a postmining use which is not the same as the preexisting use be approved by the state after consultation with the landowner or the appropriate state or federal land management agency. In addition, the proposed use must be compatible with adjacent and surrounding uses and in compliance with existing land-use policies and plans.[2] Thus, it appears that some public uses and facilities could not be deemed compatible with present uses which are predominantly agricultural. This determination would have to be based on site-specific conditions and needs and projections of land-use trends in an area. In addition to limiting redevelopment options, such planning requirements could delay the processing of premining reclamation plans, thereby constraining resource development.

(2) What Costs, Risks, and Benefits Are Involved in Redevelopment?

Economic costs and benefits are an important measure of the efficiency of the redevelopment alternative. However, because of a lack of western experience with redevelopment, these costs and benefits are not known at this time. In two of the abandoned land projects cited above, Keyser and Moraine Parks, development costs ranged from $1,100 to $6,000 per acre. The high figure is probably more representative since it includes construction of a pond within the park area, a facility that would likely be included in many redevelopment plans. Based on the review of studies cited earlier, the only generalizations that can be made are that costs vary according to the type and variety of planned facilities and that they seem to parallel reclamation costs. Clearly, economic costs would be higher if the redevelopment included a large number of recreational attractions. Also, as in reclamation costs, total costs will depend on how much earth moving is involved. These costs vary depending on the contour of the land, quantity of spoils, and distance spoils and topsoil must be moved. In one project the average cost was 16 cents per cubic yard (based on equipment operating time and not including repair and maintenance costs).[1]

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[1] Moraine State Park, which included redevelopment of 117 acres of abandoned mine lands, took about two years of time for revegetation and adequate survival rates of vegetation is included. The time frame for Friendship Park in Ohio was comparable.

[2] These requirements are stipulated in 42 Fed. Reg. 62,681 (December 13, 1977).

Benefits to states, counties, and individuals in the form of receipts or income will, like costs, vary according to the kind, number, and quality of facilities which involve the payment of usage fees by visitors (e.g., utility hookups, campsites, and cabins). Reservoirs or lakes could be stocked with sport fish to produce license fee income to states and income to private entrepreneurs from retail sales of supplies and equipment to visitors, to cite but two examples. Other benefits could accrue to the communities through jobs created and gross receipts from year-round use of the park facilities. For example, operation of Friendship Park (Ohio) requires a park commissioner and 30 to 50 employees with a yearly payroll of almost $200,000. Receipts from the park were estimated to be in the range of $500,000 per year.[2]

Viewing these facilities as a source of income for counties and states must be put in a context of risk; for example, the facilities will require careful planning to anticipate and provide for recreational needs. The risk involved here is the assessment of the "market" potential for usage fee facilities.[3] As discussed earlier, the population fluctuations associated with energy development may lead to "overbuilding" of facilities or unused facilities, adversely affecting the potential income from the parks.

(3) How Will the Costs, Risks, and Benefits Be Distributed?

A fundamental question concerning how these costs and benefits will be distributed is: what is the ratio of public and private funding to redevelop lands for public benefit? In other words, how much does the energy developer contribute towards developing the park and related amenities? Beyond basic requirements for regrading and revegetation, the developer, the landowner (if other than the developer), and related government agencies will have to determine who pays for what. Aside from the obvious benefits which will accrue to the persons who live in the area and to visitors from outside the area, the energy company could benefit from this alternative through reduced reclamation costs. For example, as noted above and in the reclamation discussion, a significant part of reclamation costs stem from earth moving (backfilling, terracing, and topsoil regrading). Some park facilities, such as ponds and motorcycle or ORV trails, could require that some part of the park lands be left unreclaimed to enhance the ruggedness of the terrain. Thus, companies would have to do only minimal regrading and terracing, thereby reducing the total earth moving costs. The risks, especially of environmental degradation and for wildlife habitat, will depend on careful site selection for such activities.

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[1] McNay, Lewis M. Surface Mine Reclamation, Moraine State Park, Pennsylvania. Washington, D.C.: U.S., Department of the Interior, Bureau of Mines, 1970, p. 23.

[2] Zande, Richard D. "Friendship Park: One Use of Reclaimed Strip Mine Land," in Bituminous Coal Research, Inc., ed. Research and Applied Technology Symposium on Mined-Land Reclamation. Monroeville, Pa.: Bituminous Coal Research, Inc., 1973, p. 294.

[3] Camin, Kathleen O., et al. Mined-Land Redevelopment. Lawrence, Kan.: University of Kansas, State Geological Survey, 1972.

Public sector economic costs, although uncertain, will probably be higher due to the cost of acquiring the land from the landowner, lost real estate taxes, and administrative costs to maintain and protect the park and the facilities in the park. But a long-term benefit can be identified with regard to future generations. New public parks in energy development areas should relieve a part of the pressure that increased populations in the West will place on "national heritage lands." On the other hand, committing lands to recreational uses means forgoing future opportunities since most of these commitments will be, for all practical purposes, irreversible.

(4) Can Redevelopment Be Used at a Variety of Sites Under a Range of Conditions?

It appears that redevelopment is best implemented on a site-specific, case-by-case basis and therefore can be applied under a variety of conditions and over time. Redevelopment requires the close cooperation of interest groups in the planning for each site, and thereby increases local and regional control of land use.

(5) How Difficult Will It Be to Implement a Redevelopment Alternative?

Implementing this alternative will require changing existing state and federal laws and requirements. Consequently, its innovation requirements are high. In addition, it increases the need for early planning and public involvement to determine what kind of facilities are needed; it demands closer cooperation among all public and private parties-at-interest; and introduces additional participants into the decision process (such as land developers).

Because of these requirements, the level of uncertainty with regard to administering and monitoring redevelopment is also high, but this is the case for all rehabilitation activities. Although administrative costs cannot be estimated from existing studies, it seems that they might be higher than for some other alternatives simply because of the cost of being flexible (it generally takes more people and time to deal with individual cases) and the extensive planning needed for the alternative to be implemented.

If cooperative agreements are reached between participants, the redevelopment to parks alternative could reduce energy-environmental conflicts, especially since it can provide an outlet for perceived recreational needs in the West. However, as stated at the beginning of this discussion, the evaluation must be viewed as exploratory since experience with this option is limited to areas outside the West. Yet, as summarized in Table 7-16, the evaluation does provide at least a general characterization of costs and benefits. Based on these findings, redevelopment of lands for public parks with recreational facilities appears to pose few problems regarding its potential success, except where states and counties view the parks as income sources; redevelopment allows lands to be returned to productive uses within a relatively short time period (2-3 years). Although economic costs have not been pinpointed, they seem to parallel those for reclamation. Beneficiaries include the public-at-large, and possibly energy companies when basic site preparation costs can be minimized as a part of the redevelopment plan. Implementation will require responsible public officials to be innovative in developing an institutional capability to administer the redevelopment flexibly and responsibly.

D. A Comparison of the Reclamation and Redevelopment Alternatives

Table 7-17 summarizes the results of a comparison of the two alternatives evaluated in this section. Several findings stand out. First, there are some obvious trade-offs that can be made by choosing one alternative rather than the other. Policymakers have to decide which values and interests they want to promote. For example, if getting lands back into production as soon as possible is the value which ranks highest, redevelopment appears to offer a significant advantage; and if minimizing cost of administration is highly valued, reclamation appears to be the most appealing choice.

The analysis of these two alternatives and the findings summarized in Table 7-17 also demonstrates that this analysis is incomplete, in part because of a lack of adequate information and resource limitations, but also because only one type of redevelopment alternative was considered. What is reported can be interpreted to imply that policymakers are faced with an either-or choice, either reclaim to predevelopment use or redevelop for a recreational use. Obviously, the choices are not this constrained. In fact, neither reclamation nor redevelopment emerges as the "best" choice: reclamation because there are areas where it will probably be impractical if not impossible; and redevelopment because there are limits as to how much and where there is an additional recreational need, and because it may also require some of the same things as reclamation, for example, revegetation. But the point that the results of our analysis leads us to make despite its limitations is that it is not at all obvious that the current policy of most states and the federal government is as well-informed a policy choice as it might be. Given the high level of uncertainty about

TABLE 7-16: A SUMMARY EVALUATION OF THE REDEVELOPMENT ALTERNATIVE

CRITERIA	MEASURES	FINDINGS
Effectiveness How effective will redevelopment for public parks be in returning lands disturbed by energy development to a productive use?	Probability of success	Potential for success is high based on results of recent development activities.
	Duration of withdrawal	Time out of use varies according to type, number, and quality of facilities planned for an area, but may be as minimal as 2-3 years.
	Compatibility	Attractive where predevelopment value of land is marginal. However, could conflict with surrounding land uses and existing land-use plans especially where adjacent lands are privately owned and used for agricultural purposes.
	Degree of constraint	Exceptional premining cooperation and planning requirements could increase time for obtaining permit, thereby eventually constraining development.
Efficiency What will be the costs, risks, and benefits associated with redevelopment?	Economic costs and benefits	Cannot yet pinpoint economic costs, but in two projects costs ranged from $1,100-$6,000 per acre. Thus, they appear to parallel reclamation costs at most western sites. Parks and facilities will create new jobs and potential for retail sales to visitors.
	Cost-effectiveness	Uncertainty over redevelopment investment pay-off time. Could provide new income if electricity and water hook-ups at campsites, or if rental cabins are provided and user fees charged.
	Risks	Reduces the potential irreversibility of land-use impacts caused by energy development. Economic risk involved concerning the market potential of user-fee projects if state or county views the redevelopment as an income source.
	Environmental costs and benefits	Most redevelopment uses will be environmentally beneficial either restrictively or by providing habitat, etc. Some recreational facilities (e.g., motorcycle and off-road-vehicle trails) will result in ecological impacts.
Equity How will these costs, risks, and benefits be distributed?	Costs	Increases economic costs of rehabilitation for the public sector in terms of: (1) acquiring the land from the owner; (2) lost revenues in property taxes; (3) administrative costs to maintain and protect parks and park facilities.
	Risks	Some recreational facilities will irreversibly commit lands to public use resulting in foregone opportunity costs should the pattern of land use change in an area. This varies according to the kinds of facilities included in the size of land commitment.

TABLE 7-16: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity (Continued)	Benefits	Benefits accrue to nearby communities who will have access to parks and facilities. Also, relieves some of the pressure on "national heritage lands" as recreational outlets. The alternative has the potential for reducing site preparation and reclamation costs for energy developers (e.g., by minimizing earth moving and backfilling requirements and topsoil handling) depending on the kinds of facilities to be constructed.
Flexibility Is the alternative sufficiently flexible to be applicable under a variety of conditions and over time?	Adaptability	Challenges the trend toward uniform reclamation standards. Requires different guidelines than for reclamation of grasslands thereby increasing need for close cooperation and planning for each site. However, increases local and regional determination of needs based on premining planning.
	Adjustability	The alternative appears to be adjustable to changing recreation needs since new facilities could be added as the need arises.
Implementability How difficult will it be to implement the alternative?	Acceptability	Redevelopment could improve the perception of energy development activities since it requires cooperation agreements from all parties-at-interest. Could also reduce energy-environment conflicts by reducing pressure on national parks and wilderness areas as places for recreation.
	Ease of administration	Innovation requirements, especially in terms of administering and monitoring redevelopment, are high--i.e., redevelopment increases the need for careful, early planning and public involvement and cooperation among public, energy developers, and land developers. Increases the number of participants in rehabilitation planning process.
	Cost of administration	Unknown, however, based on the degree of innovation required, are probably higher than for reclamation.
	Adequacy of information	Experience with the alternative has been in areas outside the West, therefore information for administering the alternative is generally inadequate.

TABLE 7-17: A COMPARISON OF THE RECLAMATION AND REDEVELOPMENT ALTERNATIVES

CRITERIA	MEASURES	FINDINGS
Effectiveness How effective will redevelopment for public parks be in returning lands disturbed by energy development to a productive use?	Probability of success	Overall, redevelopment appears to be more likely to succeed, primarily because of the uncertainty associated with reclamation in arid and semiarid areas.
	Duration of withdrawal	Redevelopment rather than reclamation can decrease the time lands are out of productive use by as much as 3 to 4 years.
	Compatibility	Either alternative can be compatible with other land uses in the surrounding area. However, unless land uses in the surrounding area change during energy resource development, returning disturbed lands to their predevelopment use is less likely to result in incompatibilities.
	Coverage	Current reclamation requirements do not apply to oil shale and uranium mining. New state and/or federal legislation would be required for either alternative to apply to surface mined lands for these two resources.
	Degree of constraint	Costs may be a constraint for both in some areas. Redevelopment planning is likely to take longer than planning for reclamation and may delay development getting underway.
Efficiency What will be the costs, risks, and benefits associated with redevelopment?	Economic costs and benefits	The level of certainty about both is not very high; however, economic costs appear to be about the same: the estimated range for reclamation is $1,000 - $7,000 per acre; and $1,000 - $6,000 for redevelopment. Both alternatives will presumably create jobs and produce products to sell.
	Cost effectiveness	The cost effectiveness of both is uncertain. In both cases, the time required to repay economic costs depends directly on the income the rehabilitated land-use activity generates. If redeveloped to a public recreational use, it may be cost-effective in a social sense even if it isn't in an economic sense. The same may be true for reclamation, but only for a smaller segment of society.
	Risks	Redevelopment appears to be more likely to reduce the possibility of the irreversibility of energy development impacts. The economic risk for both depends on the market potential of the product of the rehabilitated land.
	Environmental costs and benefits	Both alternatives can result in environmental costs; not enough is known to determine how these costs compare. However, if reclamation is unsuccessful, the environmental costs are likely to be quite high.

TABLE 7-17: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity How will these costs, risks, and benefits be distributed?	Costs	Developers and consumers will bear the costs of reclamation. If redevelopment is for public uses, public resources may be lost since the land will be off the tax rolls and will have to be maintained and managed. Revenues may or may not be adequate to make up for these costs.
	Risks	The greatest risk with reclamation is that it will not succeed, a risk borne by both the developer and society. Redevelopment seems less likely to fail, but may not preserve as broad a range of future land uses as does reclamation.
	Benefits	Both will be generally beneficial to society. Redevelopment will usually directly benefit more people than will reclamation since most rehabilitation uses will be available to nearby residents and visitors.
Flexibility Is the alternative sufficiently flexible to be applicable under a variety of conditions and over time?	Adaptability	Redevelopment is generally more adaptable, takes into account site-specific differences, and gives officials more discretionary authority in interpreting local needs.
	Adjustability	Fixed requirements make reclamation less adjustable than is redevelopment. For example, redevelopment can be adjusted to meet changing recreational needs by adding equipment and facilities.
Implementability How difficult will it be to implement the alternative?	Acceptability	Both can reduce if not eliminate energy-environmental conflicts. Both can reduce westerners concerns about bearing all the costs of producing energy for other regions. Redevelopment can also reduce the pressure of energy-related population increases on national parks, forests, etc.
	Ease of administration	It is likely to be more difficult to administer redevelopment because of the emphasis on detailed planning to meet local needs. Institutional and administrative needs will probably be greater for redevelopment.
	Cost of administration	Costs are largely unknown for both; however, based on the more extensive institutional and administrative needs anticipated for redevelopment, costs are likely to be higher for redevelopment.
	Adequacy of information	Western experience is limited or nonexistent and information is generally inadequate for administering both.

being able to reclaim arid and semiarid lands successfully, present policies seem to be an oversimplified policy response to a complex problem. A blanket policy of returning disturbed lands to their predevelopment uses largely ignores both the possibility of land-use changes in the surrounding area due to energy and other developments, and the possibility that large per-acre reclamation expenditures may be ineffective. In particular, the established need for expanded recreational opportunities for energy-related population increases challenges of the appropriateness of a policy which emphasizes only reclamation. A more balanced policy would provide for determining local needs and basing the choice between reclamation and redevelopment (and the specific redevelopment use) on what the needs are determined to be.

Clearly there is a need for more knowledge in this problem area and a need to review land-use and reclamation policies on a continuing basis. The experience gained from current developments will help to provide the knowledge base needed for this review as will the numerous research efforts currently under way.

Finally, as noted above, current laws and regulations pretty much ignore surface mining for other energy resources such as oil shale and uranium. Given the quantity of those resources in the West, this omission cannot continue unless we are prepared to have these lands withdrawn from productive uses for an extended time period.

CHAPTER 8

HOUSING

EXECUTIVE SUMMARY

Population growth associated with western energy resource development can have serious impacts on housing supply and quality in nearby communities. The majority of growth-related housing problems result because energy communities experience a rapid and large population increase which quickly declines from the peak construction level but remains higher than the predevelopment population. The private housing market does not respond adequately to meet the new housing needs created by energy development, and federal programs are not designed to deal with housing shortages in rapid-growth areas. As a result, few new homes are built, available housing is very expensive, and the use of mobile homes usually increases dramatically.

Impacts

The construction of energy facilities, especially large conversion facilities, is a major cause of population changes. Both the number of people required to construct and operate a facility and the ratio of construction to operation workers are critical causes of population-related impacts. Table 8ES-1 summarizes population changes associated with construction and operation of seven conversion facilities. These changes contribute to several impacts:

- Coal liquefaction and gasification facilities have the largest peak population increases during construction, resulting in about 14,000 to 15,500 new people in the area of typical-sized facilities. These peak population increases are nearly twice as much as those for power plants and oil shale retorts.

- Construction booms can be large but are usually short-lived, lasting from 3 years (uranium milling) to 8 years (power plants).

- The boom and bust cycle will be most dramatic for coal gasification, power plants, and oil shale retorts, since

TABLE 8ES-1: POPULATION INCREASES FROM ENERGY FACILITIES

FACILITY	PEAK POPULATIONS		RATIO OF CONSTRUCTION TO OPERATION POPULATIONS
	CONSTRUCTION	OPERATION	
Coal Gasification (250 MMcfd)	14,040	2,360	6.0
Power Plant (3,000 MWe)	7,620	1,760	4.3
Oil Shale Retort (100,000 bbl/day)	8,040	2,600	3.1
Natural Gas Production (250 MMcfd)	5,100	3,160	1.6
Coal Liquefaction (100,000 bbl/day)	15,660	12,240	1.3
Crude Oil Production (100,000 bbl/day)	11,760	12,200	1.0
Uranium Milling (1,200 tpd)	270	440	0.6

MMcfd = million cubic feet per day
MWe = megawatt-electric
bbl/day = barrels per day
tpd = tons per day

each of these facilities has a high ratio of construction to operation populations (Table 8ES-1). In contrast, coal liquefaction, crude oil production, and uranium milling have relatively stable populations.

Western towns facing this rapid and fluctuating population growth because of energy development are likely to experience severe housing problems. Few homes are built and few, if any, apartments or other housing types are available in most energy-impacted communities. Consequently, mobile homes are usually the only alternative available to residents (see box, "Boomtown Housing").

The Policy Context

Two critical factors combine with the impacts of energy resource developments to create these housing problems:

- Risks of housing construction in boomtowns are apparently too great for lenders, developers, and energy firms to invest in these towns. Housing is traditionally a private market service, and without direct financing of home construction and mortgages by local financial institutions, few new homes can be built.

- Public sector programs have not dealt effectively with the housing problem and no federal programs are directed toward the specific housing shortages in energy related, rapid-growth situations. Although several western states have established housing finance programs designed to overcome the lack of mortgage money and federal assistance, these actions have had little effect on housing markets.

The reluctance of local lenders and the resultant low level of homebuilding activity have had a dramatic effect on housing prices, causing further housing shortages. The 1977 average price of new homes in western energy-impacted communities was about 30 percent higher than the national average for nonmetropolitan areas, while apartment rents (in towns where they are available) were nearly double the national median.

BOOMTOWN HOUSING

"During the Sweetwater County, Wyoming boom's early stages, the housing stock of the county was approximately doubled with 6,000 new units. Fifty-five hundred of these were mobile homes... The housing market demand drove prices and rents up, yet investors and developers were skeptical of putting money into boom-town housing. Even if they had been willing, mortgage money was not available for the typical miner wishing to buy a home. This same pattern is reproduced in most boom-towns. Even when mining or utility companies bring housing into being, little or no provision is made for the local service workers who must also be accommodated in a fast growing community."

--Gilmore, John S. Prepared statement in U.S., Congress, Senate, Committee on Environment and Public Works. Inland Energy Development Impact Assistance Act of 1977. Hearings before the Subcommittee on Regional and Community Development, 95th Congress, 1st session, August 2 and 27, 1977, pp. 266-67.

Energy developers have tried to alleviate housing shortages for their employees by supporting mobile home parks (see box "Wright Again"), single- and multifamily developments, and developing company towns such as Colstrip, Montana. Single-family subdivisions are becoming more common, largely because of the overwhelming preference of families for such homes. Energy firms typically give preference to their employees in allocating such housing, so outside contractors and service workers in nearby towns seldom benefit from these actions.

Because of the failure of lenders, developers, and the public sector to successfully address housing problems, several issues related to the overuse of mobile homes are likely to intensify as energy resource development increases:

- Dissatisfaction with mobile home parks will increase because the homes are usually very close together, paved streets are rare, park maintenance is often inadequate, and parks are generally clustered outside of towns.

- Mobile home ownership has few of the financial advantages of a conventional single-family home. Except in Wyoming, mobile homes are considered personal rather than real property, and interest on personal property loans tend to be 2 to 3 percent higher than on mortgage loans. Also, the value of mobile homes often depreciates rapidly, in contrast to single-family homes which usually increase in value.
- Mobile homes designated as personal property contribute little to local government tax roles. Thus, housing problems are related to the inability of local governments to provide adequate services and facilities to expanding populations.

WRIGHT AGAIN

Wright, Wyoming, has reappeared on the map after a 40-year absence. A ranch house post office closed its doors during the Depression, but the name has been given to a mobile home park for employees of ARCO's Black Thunder Mine 40 miles south of Gillette. By living closer to the mine than they would have in Gillette, the only town in Campbell County, workers will commute shorter distances. But this alternative has been at considerable cost to ARCO. The telephone system which cost $600,000 would have cost ARCO nothing in Gillette. Families still must drive to Gillette for shopping and other services.

--"Town Revived in Coal Boom." Denver Post, July 13, 1976; and Enzi, Michael, Mayor of Gillette, Wyoming. Personal communication.

Alternative Policies

Three overall objectives can be identified for improving housing in energy-impacted communities: (1) reduce the peak demand for temporary housing; (2) use the existing housing market to increase the quantity of housing financing and construction; and (3) improve the quality of housing. General categories of alternatives and specific alternatives for achieving these objectives are listed in Table 8ES-2.

Policymakers can reduce housing demand by decreasing the size of the labor force living on-site. Specific policy responses are to adjust project schedules, encourage long-distance commuting, or encourage facility siting choices which consider the impacts of various technological and locational factors. These alternatives generally add costs and delays to energy development; for example, adjusting project schedules can add 5 percent to the annual construction costs. Thus, energy firms are not likely to initiate them without inducements, such as financial incentives or state siting requirements. If construction workers commute to the site from metropolitan areas, peak demands for temporary housing will spread over a wider area and risks of overbuilding in any nearby community is reduced.

TABLE 8ES-2: POLICY OBJECTIVES AND ALTERNATIVES FOR HOUSING

POLICY OBJECTIVE	CATEGORY OF ALTERNATIVES	SPECIFIC ALTERNATIVE
Reduce the peak demand for temporary housing	Decrease the number of workers living on-site	Adjust project schedules Long distance commuting Siting based on technological/locational factors
Increase the quantity of housing financing and construction through the private market	Increase the quantity of housing construction	Make state siting permits conditional on housing Stimulate industry investment in housing
Improve housing quality	Diversify housing mix	Tax incentives for rental housing Financial assistance for lenders and developers of apartments, condominiums, and town houses
	Improve mobile home situation	Change financial and tax structure for mobile homes Develop quality mobile home parks Institute local land-use controls for all areas of a county

To increase homebuilding activity, policymakers can make siting permits conditional on provision of adequate housing, stimulate industry investment in housing, increase guarantees in the secondary mortgage market, and provide grants and loans to developers. States can become involved in these actions, particularly through siting procedures. However, siting permit requirements could increase the costs and risks of development, unless all western states adopted similar requirements, thereby discouraging energy developers from making investments only in some states.

Policymakers may also choose to improve housing quality by diversifying the housing mix or improving the mobile home situation. Incentives can be given to local lenders, developers, and renters to encourage the construction and purchase of alternative housing types. Even if policymakers can successfully diversify the housing choices available in western boomtowns, mobile homes will still remain the predominant housing type in the immediate future. Thus, a third category of alternatives is to improve the quality of mobile homes. One specific alternative would change the tax classification from personal to real property, making them eligible for lower interest loans and slowing their depreciation rate. Two other alternatives to improve the quality of mobile homes are the development of quality mobile home parks, and the extension of land-use controls to all areas of the county to facilitate control of mobile home parks.

Findings

Three categories of alternatives to improve the housing situation have been evaluated in this policy analysis: decrease the number of workers living on-site, increase the quantity of housing construction, and increase the financing available for new home construction. The results of our analysis suggest that if policymakers choose to reduce the number of workers living on-site, the following results can be anticipated.

- Each of the specific alternatives--long distance commuting, adjusting project schedules, and siting considerations--can effectively reduce the number of temporary workers living on-site. As shown in Figure 8ES-1, if construction schedules for coal gasification plants are extended from five to eight years, peak employment and associated temporary housing demand could be reduced by about one-third during the construction phase. If workers were encouraged to commute long distances, the reduction in local peak demand for temporary housing would correspond to the proportion of the work force commuting. Consideration of siting

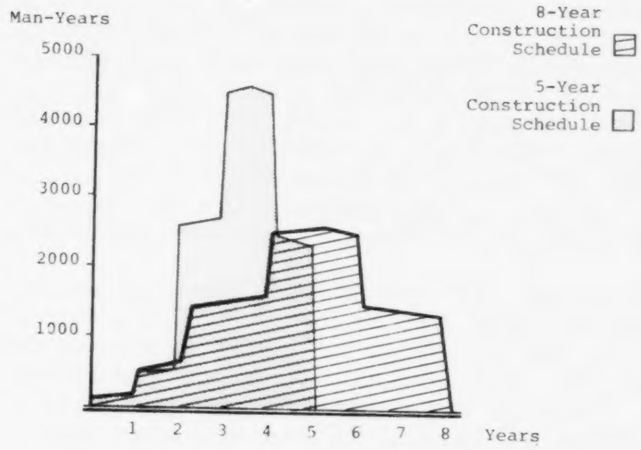

Figure 8ES-1: Personnel Requirements For Coal Gasification Plant Construction

Source: Carasso, M., et al. The Energy Supply Planning Model, Vol. 1. San Francisco, Calif.: Bechtel Corporation, 1975, pp. 6-30 to 6-31.

choices to match technologies and locations could avoid many housing problems if the most labor-intensive technologies were prohibited in areas least capable of handling population increases.

- Adjusting project schedules will have the highest economic costs among these three alternatives. They include increased interest costs for financing as well as inflation of construction costs and consequent increases in energy prices paid by consumers. The costs and risks of the commuter and siting alternatives appear lower, since neither would delay the start of energy production and communities would face less risk of overbuilding for a boom that failed to materialize.

- Adjusting project schedules raises questions about the distribution of costs, risks, and benefits. Industry would presumably pass increased construction and financing costs on to consumers. These consumers, especially those outside the West, will likely resent having to pay higher prices for energy. This situation is not necessarily inequitable, since many westerners feel ultimate energy users should pay the "full costs" of producing the energy. However, the perceived inequities in cost-sharing will probably increase interregional conflicts. Second, increased construction times could delay goals of the national energy plan to convert from oil and gas to coal.

- The amount of new housing generated by these alternatives is uncertain. Based on limited experience with housing programs in the West, the alternative to siting permits contingent upon industry agreement to provide additional housing appears to be more effective than stimulating investment or providing guarantees.

- The costs of housing construction programs can range from $5,000 per unit for site development alone, to more than $30,000 per unit for house construction. On the other hand, firms face the risk of holding unsold homes if energy development plans are delayed or cancelled.

- Siting permits conditional on industry provision of housing are especially flexible in dealing with energy development impact needs of specific communities. Industry's willingness to provide housing for its workers will depend both on the advantages of the siting procedure and on the incentives offered by the states and federal governments. Generally, permit application procedures that result in time and cost savings will be more acceptable to industry.

Conclusion

Many housing problems associated with western energy resource development can be avoided if policymakers locate fewer workers in small western communities. Long-distance commuting, adjustment of project schedules, and discouraging the most labor-intensive technologies in some areas could significantly reduce housing demands. Housing shortages, and to a lesser extent, poor housing quality could be mitigated by policies to increase financing and construction funds.

This analysis also suggests that federal programs will be more difficult to enact and implement than state or private sector responses. This is in part because federal programs characteristically apply uniform policies, whereas the housing needs of western boomtowns vary considerably by area and type of development. It is also because interregional disputes, likely to be worsened by housing issues, may make it more difficult to apply federal programs to meet the needs of one region. This suggests that western areas facing large population changes will increasingly need the assistance of state governments, energy developers, and private investors.

CHAPTER 8

HOUSING

8.1 INTRODUCTION

Energy resource development will create a housing shortage in most energy-impacted communities. Housing will be inadequate, both in quantity and quality; and housing costs will be greatly inflated. These problems are a consequence of the population growth associated with energy development. When energy development begins, a large, rapid population increase occurs. This increase, which often exceeds the predevelopment population of the community, is usually larger during construction than during operation. This fluctuation exacerbates the housing problem.

In communities that have experienced these impacts, the private market has not met the new needs created by energy development, and current federal programs are not designed to deal with housing shortages in rapid-growth areas. As a consequence, conventional housing is expensive and difficult to obtain and mobile homes provide a high percentage of the housing for newcomers.

Housing is but one component of the planning and growth management problems experienced when energy resources are developed in the West.[1] Other aspects of the growth management problem area are discussed in Chapter 9. Most of these problems are a consequence of population growth associated with energy development. Consequently, a general overview of the growth phenomenon provides a framework for both chapters.[2]

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[1] The identification of local services, planning, and housing as major problem areas is similar to those identified in Bolt, R.M., et al. Boom Town Financing Study. Denver, Colo.: Colorado Department of Local Affairs, 1976, Vol. 1, p. 36. See also U.S., Congress, Senate, Committee on Environment and Public Works. Inland Energy Development Impact Assistance Act of 1977. Hearings before the Subcommittee on Regional and Community Development, 95th Congress, 1st session, August 2 and 27, 1977.

[2] Related topics, such as energy transportation and energy facility siting, are discussed in greater depth in Chapters 11 and 12.

Most growth-related problems which communities in energy resource areas have to deal with result either from large and rapid population increases or population fluctuations which result from differences in the work force required during construction and operation. Siting energy conversion facilities near mines results in the greatest local impacts on western towns.[1]

The magnitude or rate of population growth that begins to affect communities seriously is not easy to identify, even though recent rapid growth in many western towns has been well documented. An annual growth rate of five percent (which will double the population in 14 years) tends to produce serious impacts for a community.[2] Rock Springs, Wyoming, for example, grew at an annual rate of 19 percent from 1970 to 1974, and rapid growth has been a serious problem in many western towns (Table 8-1). Rapid growth is a greater problem for small communities than for large towns, as discussed in Section 8.1.1.C.

Private sector services such as housing and retailing tend to lag behind local needs in rapid growth situations. Since temporary, short-term construction activity does not provide a stable market or tax base, it is difficult to associate energy development with long-term urban and economic growth in western towns. As a result, private sector parties to western energy development have not responded to many of the needs of western communities and their residents.

Housing is a particularly severe problem in western towns affected by energy development. It has long been a private market service, rather than one provided by government, but the usual market forces are not providing the quantity or quality of housing needed in many western communities. Home construction is going on only in the larger towns, and mobile homes "are everywhere."[3]

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[1] Energy facility locations outside the West, even when using western resources, are not the focus of this problem area. These broader issues are discussed in the analysis of energy facility siting found in Chapter 12.

[2] Gilmore, J.S., and M.K. Duff. Boom Town Growth Management. Boulder, Colo.: Westview Press, 1975, p. 2. See also U.S., Federal Energy Administration, Region VIII, Socioeconomic Program Data Collection Office. Regional Profile: Energy Impacted Communities. Lakewood, Colo.: Federal Energy Administration, 1977, p. 20, for alternative criteria.

[3] Federal Interagency Team. The Energy Boom in Southwest Wyoming. Washington, D.C.: U.S., Department of Housing and Urban Development, 1976; U.S., Congress, Senate, Committee on Environment and Public Works. Inland Energy Development Impact Assistance Act of 1977. Hearings before the Subcommittee on Regional and Community Development, 95th Congress, 1st session, August 2 and 27, 1977.

TABLE 8-1: POPULATION GROWTH IN SELECTED WESTERN COMMUNITIES, 1970-1977

TOWN	ENERGY RESOURCE IMPACT	POPULATION		AVERAGE ANNUAL INCREASE
		1970	1977	PERCENT
Colorado				
Carbondale	Coal	726	1,600	17
Craig	Coal	4,205	6,657	8
Grand Valley	Oil Shale	270	500	12
Rifle	Oil Shale	2,150	3,500	9
Montana				
Hardin	Coal	2,733	3,637	5
North Dakota				
Washburn	Coal	805	1,400	10
Utah				
Cedar City	Coal	8,946	12,000	5
Huntington	Coal	857	1,700	14
Vernal	Oil Shale	3,908	5,200	5
Wyoming				
Douglas	Coal, Uranium, Oil, Gas	2,677	7,200	25
Gillette	Coal, Oil, Gas, Uranium	7,192	10,200[a]	6
Moorcroft	Coal, Gas, Oil, Uranium	981	2,000	15
Rock Springs	Coal, Gas, Oil	10,500	23,250	17
Wheatland	Coal	2,500	4,500	11

Source: U.S., Federal Energy Administration, Region VIII, Socioeconomic Program Data Collection Office. Regional Profile: Energy Impacted Communities. Lakewood, Colo.: Federal Energy Administration, 1977.

[a] This estimate of Gillette's population is probably low. Other estimates for 1977 put the city's population at 12,500-14,000, a growth rate since 1970 of 10-13 percent. See Campbell County Chamber of Commerce. Economic Impact of Anticipated Growth: City of Gillette and Campbell County, Wyoming. Gillette, Wyo.: Campbell County Chamber of Commerce, 1976.

Too-rapid population growth, local financial market conditions, and uncertainty about the future of energy development all contribute to a shortage of housing in all energy impact towns. The national system of housing financing and construction is not working effectively in towns affected by western energy development.

8.1.1 The Population Growth Impacts of Energy Resource Development

In attempting to identify combinations of energy technologies and locations that would minimize or avoid impacts, several critical factors were identified as significantly affecting energy development impacts.[1] The factors that affect growth management related impacts can be divided into technological and locational factors. Critical technological factors include labor requirements and scheduling; locational factors include community characteristics such as size and location and the jurisdictional distribution of revenues.

A. Labor Requirements

Many energy facilities require far more personnel during construction than during operation. This is particularly true for coal conversion and oil shale processing technologies whose operation is capital rather than labor intensive, and for which construction requires over four times more personnel than operation (Table 8-2). Larger numbers of workers, over half of whom bring their families to construction jobs, require a range of local services and facilities, including housing. In addition to the persons directly employed in energy development, there is an indirect population increase due to service and support personnel in nearby towns. This further increases the need for housing and services.

As shown in Table 8-2, direct population impacts, as measured by person-years, are generally greater for conversion than for mining. In addition, there are large differences in the labor intensity of conversion technologies, as indicated by the peak construction employment and operation employment columns in Table 8-2. The construction/operation employment ratio also indicates the boom-bust cycle associated with large construction projects. More capital-intensive facilities involve larger booms in local employment, but they also result in greater employment declines when construction work is completed.

B. Scheduling

Scheduling can play a major role in determining the actual magnitude of population impacts. For example, construction of a coal gasification facility normally takes about five years. The population impacts during construction are typical of large-scale energy projects; thousands of people are needed for only a short time (Figure 8-1-A). Simultaneous construction of two facilities

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[1] White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977.

TABLE 8-2: CONSTRUCTION AND OPERATIONAL PERSONNEL REQUIREMENTS FOR ENERGY FACILITIES

FACILITY (and size)[a]	MANPOWER REQUIREMENTS (person-years)					CONSTRUCTION/ OPERATION EMPLOYMENT RATIO[d]
	CONSTRUCTION			OPERATION		
	DURATION (years)	PEAK EMPLOYMENT	PEAK POPULATION[b]	EMPLOYMENT	POPULATION[c]	
Coal						
Surface Mine (12.7 MMtpy)	5	210	630	550	2,200	0.4
Underground Mine (12.7 MMtpy)	6	820	2,460	3,000	12,000	0.3
Gasification (250 MMcfd)	5	4,680	14,040	590	2,360	8.1
Liquefaction (100,000 bbl/day)	7	5,000	15,000	2,930	11,720	1.7
Power Plant (3,000 MWe)	8	2,540	7,620	440	1,760	5.8
Oil Shale						
Underground Oil Shale Mine (26 MMtpy)	4	360	1,080	590	2,360	0.6
Modified In Situ Oil Shale Processing (57,000 bbl/day)	6	1,950	5,850	510	2,040	3.8
TOSCO II Oil Shale Processing (50,000 bbl/day)	6	1,340	4,020	330	1,320	4.1
Oil						
Conventional Crude Oil Production[e] (50,000 bbl/day)	7	3,920	11,760	2,050	8,200	1.9
Gas						
Natural Gas Production[e] (250 MMcfd)	4	1,700	5,100	790	3,160	2.1
Uranium						
Surface Mine (Open Pit) (1,100 mtpd ore)	5	80	240	180	720	0.4
Underground Mine (1,100 mtpd ore)	8	80	240	930	3,720	0.1
Solutional Mine (250 tpy yellowcake)	2	50	150	60	240	0.8
Mill (1,000 mtpy yellowcake)	3	90	270	110	440	0.8
Geothermal (100 MWe)	3	290	870	28	110	10.3

MMtpy = million tons per year
MMcfd = million cubic feet per day
bbl/day = barrels per day
MWe = megawatt-electric
tpd = tons per day
mtpd = metric tons per day

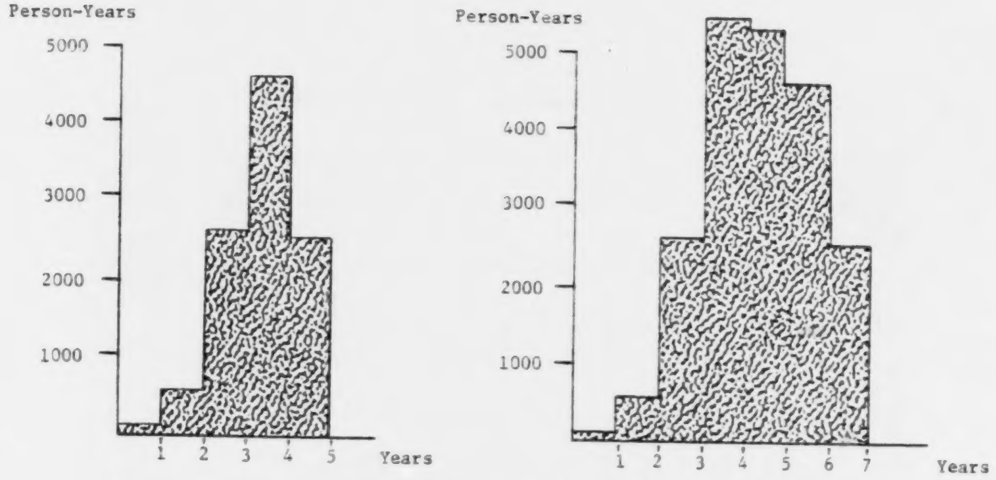
[a] The facility size listed is that assumed in the impact analyses in White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming, Chapter 3. Data are from Carasso, M., et al. The Energy Supply Planning Model. San Francisco, Calif.: Bechtel Corporation, 1975, Vol. I, pp. 6-30 to 6-31, and involve uncertainties of -10 to +20 percent; data for developing technologies (coal liquefaction, gasification, and oil shale processing) involve uncertainties of -30 to +75 percent.

[b] Using a population/employment multiplier of 3.0.

[c] Using a population/employment multiplier of 4.0.

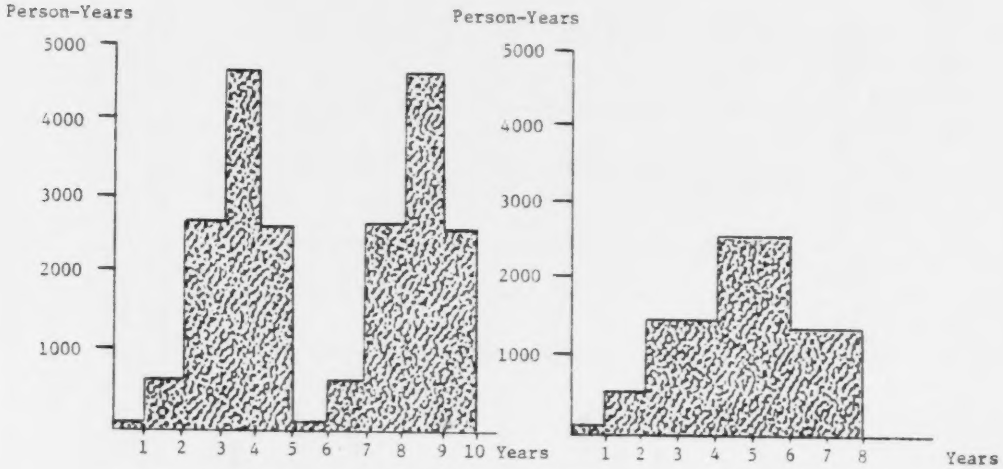
[d] The larger the ratio, the greater the employment decline when construction ends.

[e] Includes exploration (including dry holes), development, and production. See Carasso et al. Energy Supply Model, Vol. I, pp. 6-7 to 6-15.



8-1-A: Normal 5-Year Construction Schedule - One Facility

8-1-B: Two Facilities - Second facility started two years after first compounds impacts



8-1-C: Two Facilities - Second facility started when first is completed makes severe peaks and falls in impacts

8-1-D: One Facility - Lengthening construction schedule to 8 years reduces peak labor requirements and impact

FIGURE 8-1: PERSONNEL REQUIREMENTS FOR COAL GASIFICATION PLANT CONSTRUCTION AND IMPACTS FROM VARIOUS SCHEDULES (Populations associated with each year would be about 3.0 times greater than employment.)

Source: Carasso, M., et al. The Energy Supply Planning Model, Vol. 1. San Francisco, Calif.: Bechtel Corporation, 1975, pp. 6-30 to 6-31.

brings larger numbers of people to an area, increasing the needs for all services. If a second gasification facility were constructed two years after the first, a longer period of temporary impact occurs (Figure 8-1-B). In this situation, there is a risk that the impacts and needs during a seven-year construction period can be expected to continue over the long term.[1] Consecutive construction projects cause a smaller absolute impact, but can result in more severe peaks and drops in population impacts (Figure 8-1-C). If construction of the second facility is delayed, planning for impacts on the basis of an uncertain schedule may be more difficult. By extending the construction phase of a single project, the cyclical pattern can be smoothed out, thereby reducing the need for temporary facilities (Figure 8-1-D).[2] Smaller size facilities would somewhat reduce labor needs but, because of economies of scale, the impact from a facility one-half the typical size would tend to be greater than half the full-scale impact.[3]

C. Community Size and Location

The most important factor influencing the extent of population impact is the size of a community before energy development begins. Larger cities (over 10,000 population) generally serve as major market centers for a wide area and, therefore, have more diversity and capacity for growth in both the public and private sectors.

In addition to size, the isolation of a town and the number of communities in the vicinity of an energy development will affect the relative impacts on each town. An isolated town where nearly all workers and their families will live will be impacted more severely than will any one town in an area where the new population is distributed among several towns. For example, Gillette, an isolated community in northeastern Wyoming, has been impacted more severely by energy development than have either Rifle, Grand Valley, Meeker, or Rangely in western Colorado. In the latter case, several towns have shared the impacts.

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[1] This occurred in several places along the route of the Alaskan pipeline. See Gilmore, J.S., and M.K. Duff. Boom Town Growth Management. Boulder, Colo.: Westview Press, 1975.

[2] The schedule in Figure 8-1-D extends any yearly labor requirement above 2000 man-years over a two-year period. Thus, the requirements of the middle three years in 8-1-A are reduced by half and the construction period is extended from five to eight years. The implications of such a schedule are discussed in Section 8.4.

[3] U.S., Federal Energy Administration. Project Independence Blueprint Final Task Force Report--Synthetic Fuels from Coal. Washington, D.C.: Government Printing Office, 1974, p. 38.

8.1.2 Effects on the Quality-of-Life

Energy development can seriously affect the everyday lives of residents of impacted communities. Quality-of-life in part consists of individuals' reactions to the adequacy of public and private services. Inadequacies in these services translate directly into a perceived adverse quality-of-life for residents.

It is easier to document the inadequacies of public and private services in small energy-impacted towns than it is less tangible effects such as social stress. Long-time residents, in particular, are often affected simply because they were against change. As a result, an animosity between newcomers (who personify that growth) and long-time residents can easily develop.[1] However, there is some evidence that this ill will is more perceived than real.[2] The conventional wisdom is that newcomers are kept out of long-time residents' society, a social distance that particularly affects women and school children.[3]

The most comprehensive survey of residents' satisfaction with local services was done as part of the Construction Worker Profile.[4]

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[1] Fradkin, P.L. "Craig, Colorado: Population Unknown, Elevation 6,185." Audubon, Vol. 79 (July 1977), pp. 118-27; University of Montana, Institute for Social Science Research. A Comparative Case Study of the Impact of Coal Development on the Way of Life of People in the Coal Areas of Eastern Montana and Northeastern Wyoming. Missoula, Mont.: University of Montana, Institute of Social Science Research, 1974.

[2] Newcomers in two Wyoming towns believe old-timers see them much more negatively than the old-timers actually do. See Uhlmann, J.M., R. Kimble, and D. Throgmorton. A Study of Two Wyoming Communities Undergoing the Initial Effects of Energy Resource Development in the Powder River Basin: Buffalo and Douglas, Wyoming - 1975. Cheyenne, Wyo.: University of Wyoming, Department of Anthropology, 1976, pp. 56-67.

[3] Kneese, Allan V. "Mitigating the Undesirable Aspects of Boom Town Development," in Federation of Rocky Mountain States. Energy Development in the Rocky Mountain Region: Goals and Concerns. Denver, Colo.: Federation of Rocky Mountain States, 1975, pp. 74-76.

[4] Mountain West Research. Construction Worker Profile, Final Report and Community Reports. Washington, D.C.: Old West Regional Commission, 1976. This study included a Project Survey, concerning the location, origin, and family characteristics of 3,168 energy construction workers on 14 projects; and Household Survey of 1,432 households in nine western communities (five currently affected by construction, two postimpact towns, and two preimpact towns), and a Community Survey utilizing participant observation in three communities.

The composite results from the nine communities surveyed reveal that long-time residents tend to be more satisfied with local services than are newcomers, and that college-educated and high-income households are more dissatisfied with local services.[1] Long-time residents seem to see a need for improvement in such services as streets, water supply, and housing; newcomers also tend to prefer an improved range of shopping, entertainment, and other private businesses.[2] Both groups, however, agree that improvement is needed in impacted communities.

8.1.3 Organization of the Paper

This chapter deals with housing, a need traditionally met by the private sector. Section 8.2 discusses the context of housing problems and issues in the West. Policy alternatives and implementation strategies for these problems and issues are described and evaluated in Section 8.3 and a summary and comparison of alternatives is presented in Section 8.4

8.2 THE CONTEXT OF HOUSING ISSUES IN THE WEST

Housing in this country has traditionally been provided by the private sector. In most circumstances, the private market operates satisfactorily, although some governmental programs have been established to help meet the needs of low- and moderate-income families. In virtually all cases of government action, however, public sector programs have worked through the private housing market mechanisms. In situations involving rapid or large population changes, such as occur in communities located near energy resource developments in the West, the private housing market does not respond adequately. The lack of programs capable of dealing with housing shortages in small towns experiencing rapid growth has forced the market to rely on mobile homes as the principal housing type for both temporary (construction phase) and permanent residents. This reliance on mobile homes is contrary to both the preferences and abilities of many families whose incomes are above the average national level.

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[1] Mountain West Research. Construction Worker Profile, Final Report. Washington, D.C.: Old West Regional Commission, 1976, pp. 57-58.

[2] Mountain West Research, Construction Worker Profile, Community Reports. Washington, D.C.: Old West Regional Commission, 1976. This was the same trend found in the study by Uhlmann, J.M., R. Kimble, and D. Throgmorton. A Study of Two Wyoming Communities Undergoing the Initial Effects of Energy Resource Development in the Powder River Basin: Buffalo and Douglas, Wyoming - 1975. Cheyenne, Wyo.: University of Wyoming, Department of Anthropology, 1976.

This section presents the background for the current housing situation in western towns affected by population growth from energy development. Two housing issues prevalent in western towns are discussed below: financing and construction, and housing quality. A separate section on Indian housing is also included. These provide the context for housing problems and the policy alternatives in the following section.

8.2.1 Housing Financing and Construction

The private housing market involves a number of mechanisms that seem to work inadequately in communities experiencing energy development impacts. The population influx associated with energy facilities (Section 8.1.1 above) generates a demand for housing that typically is met by mobile homes rather than conventional housing.[1] Constraints in financing provide bottlenecks in the usually smooth operation of the housing demand (Figure 8-2, Step 1).

A. Uncertainty and Risk

The market for new housing is almost completely dependent on the employment prospects in energy development. Projects involving advanced technologies may be cancelled, mines may be shut down before mortgages would be paid off, or projects may be delayed for up to several years, all of which make the risk of being left with unsold homes too great.[2] Although secondary development associated with energy facilities usually will increase the market for housing, existing capabilities for predicting the size of the secondary population are imprecise at best.[3]

The uncertainty involved in western boomtown housing pervades the entire area of housing financing. Lenders, housing developers, and builders cannot afford to rely on the announced schedules for advanced energy technologies, which leave them holding unsold

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[1] There is some demand for mobile homes in affected communities, but preferences for single-family housing far outnumber those for mobile homes. See Mountain West Research. Construction Worker Profile, Final Report. Washington, D.C.: Old West Regional Commission, 1976, p. 103. The subject of housing mix is considered in Section 8.2.2 below.

[2] University of Denver, Research Institute, Industrial Economics Division. Methodology Papers: Housing. Denver, Colo.: Denver Research Institute, 1977.

[3] See White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

STEP	ITEMS CONSIDERED
1. Market Research	demand for housing
2. Land Acquisition	location, area, drainage, zoning, utilities, and other considerations
3. Subdivision and Development	streets and utilities put in
4. Building Permit	according to local laws and regulations
5. Construction Loan	generally local loans watched closely by local lenders
6. Construction	often involving a surety bond to guarantee completion
7. City Certification of Occupancy	local building standards have been met
8. Sale of Home and Permanent Financing	mortgagee gets local long-term loan
9. Sale of Mortgage to Government or Private Investors	secondary mortgage market

FIGURE 8-2: TYPICAL SEQUENCE OF HOUSING DEVELOPMENT

Source: Adapted from Nelson, G.S., and D.A. Whitman. Cases and Materials on Real Estate Finance and Development. St. Paul, Minn.: West, 1976. (The length of time necessary for each step in the sequence varies considerably from community to community and situation to situation.)

homes when projects are delayed. The private secondary mortgage market (Figure 8-2, Step 9), made up principally of linkages between savings and loan associations and government agencies and insurance companies, may be unwilling to back investments that are not in low-risk categories. Even when permanent financing is available, construction financing is often difficult to obtain (Figure 8-2, Step 5). For example, a mine, projected to be active for 20-25 years, provides an employment base for a town shorter than the life of a typical (30-year) mortgage on a new home.

The potential demand for new homes is somewhat more certain in larger towns, such as Gillette and Farmington, where large numbers of energy development executives or administrative personnel live. For energy facility construction personnel, however, their temporary stay in the community and uncertainty about future energy development result in a fear of overbuilding for the long term. This is particularly true of towns that have had previous booms followed by busts; these events have made some local financial institutions very cautious about current energy development.

If homes might not be needed for some future period, it is difficult to obtain financing for home construction even though housing shortages occur. Jack Presnell of Phillips Petroleum Company summarizes the view of lenders in northwestern New Mexico: "There is a natural reluctance on the part of the traditional private lending agencies to lend mortgage money in situations like this until they can see more what the future holds."[1]

The reluctance of local lenders and the low level of homebuilding activity which results has had a dramatic effect on home prices (Table 8-3). The average price of new homes (around $50,000) is about 30 percent higher than the national average for nonmetropolitan areas, and apartment rents are nearly double the national figure of $120 per month.

The reluctance of local lenders is attributable in part to the funds available at the national level. Local financial markets in the West are unable to accommodate the demand for new mortgages in rapidly growing small communities. External financing is constrained by the absence of financial relationships with out-of-state institutions and the inability of local financial institutions to accumulate sufficiently large blocks of mortgages to sell in secondary mortgage markets.[2] These shortcomings of the mortgage market in the rural West have intensified in recent years as the secondary mortgage market tripled in volume from 1970 to 1976.[3] The importance of these connections applies both to the federal agencies involved and to private sector institutions.

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[1] Presnell, Jack. Testimony in U.S., Congress, Senate, Committee on Environment and Public Works. Inland Energy Development Impact Assistance Act of 1977. Hearings before the Subcommittee on Regional and Community Development, 95th Congress, 1st session, August 2 and 27, 1977.

[2] Carlisle, N. "Boomtown Housing: The Problems and Possible Solution," in Bronder, L., N. Carlisle, and M. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977, p. 492; Wyoming, Department of Economic Planning and Development, Office of the Chief of State Planning. Housing Finance: Implications for the State of Wyoming. Cheyenne, Wyo.: Department of Economic Planning and Development, 1977.

[3] Brockschmidt, P. "The Secondary Market for Home Mortgages." Monthly Review, Federal Reserve Bank of Kansas City, September-October 1977, pp. 11-20.

TABLE 8-3: AVERAGE PRICE AND TOTAL MONTHLY COSTS OF HOUSING TYPES IN WESTERN IMPACTED COMMUNITIES

STATE	AVERAGE TOTAL MONTHLY COST			TYPICAL DOWN PAYMENT	AVERAGE PRICE	
	THREE-BEDROOM SINGLE-FAMILY HOME	TWO-BEDROOM MOBILE HOME	UNFURNISHED TWO- TO THREE-BEDROOM APARTMENT	THREE-BEDROOM SINGLE-FAMILY HOME	THREE-BEDROOM SINGLE-FAMILY HOME	TWO-BEDROOM MOBILE HOME
Arizona	302	210	125-250	20%	39,000	10-15,000
Colorado	404	239	200-250	20%	46,000	10-15,000
Montana	337	213	150	20%	40,000	10-15,000
New Mexico	425	176	250	10%	50,000	10-15,000
North Dakota	395	195	200-240	20%	50,000	10-15,000
Utah	385	191	250-300	20%	50,000	10-15,000
Wyoming	410	197	285-385	10-20%	50,000	10-15,000
U.S. Median Outside Metropolitan Areas, 1976			$120		37,000	

Source: Carlisle, N. "Boomtown Housing: The Problems and Possible Solution," in Bronder, L., N. Carlisle, and M. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977, p. 492; U.S., Department of Commerce, Bureau of Census. Annual Housing Survey: 1975, United States and Regional. Washington, D.C.: Government Printing Office, 1977; U.S., Department of Commerce, Bureau of Census. Characteristics of New Housing: 1976, Construction Report Series C25-76-13. Washington, D.C.: Department of Commerce, 1977, p. 48.

B. Government Activities in Housing Financing

The federal government's major role in the housing market is through federally-chartered agencies that purchase mortgages initiated by local institutions. This secondary mortgage market thus makes more funds available to mortgage lenders, and is intended to balance out the supply and demand of mortgage funds. The Federal National Mortgage Association (FNMA or Fannie Mae), the Governmental National Mortgage Association (GNMA or Ginnie Mae), and the Federal Home Loan Mortgage Corporation (FHLMC or Freddie Mac) all purchase mortgages, often for resale. Although the three institutions are able to purchase conventional mortgages, they have tended to concentrate on loans insured by the Federal Housing Administration (FHA) or guaranteed by the Veterans Administration. FHLMC is specifically intended to operate in the conventional mortgage sector and is moving in that direction. In addition, the Federal Home Loan Bank Board extends credit in the form of advances to its member institutions (mainly savings and loan associations).[1]

While the above institutions reduce the risk to lenders associated with home mortgages, they only indirectly affect the availability of money. As home prices and interest rates rise, federally-insured loans at reduced interest rates become potentially more important. The FHA places limits on house prices and buyer incomes for reduced-rate loans under some programs. Nationwide, FHA loans have accounted for 15 to 30 percent of the home mortgage market, and the percentage has been declining in the 1970's, largely because FHA interest rates are substantially lower (as much as one and one-fourth percent) than market rates.[2] The use of FHA loans is low for several reasons: periodic construction inspections, slow processing times, low administered interest rates, heavy documentation requirements, and "red tape." Builders must pay closing costs (points) to bring the interest rate up to market rates. The scarcity of mortgage bankers and savings and loan associations (which tend to be linked to the secondary mortgage market) in rural areas further decreases the use of FHA programs.[1]

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[1] Nelson, G.S., and D.A. Whitman. Cases and Materials on Real Estate Finance and Development. St. Paul, Minn.: West, 1976, pp. 483-87. For additional information on the activities of each agency, see Brockschmidt, P. "Secondary Market for Home Mortgages." Monthly Review, Federal Reserve Bank of Kansas City, September-October 1977, pp. 11-20.

[2] Nelson and Whitman. Cases and Materials.

Retirees and others on fixed incomes are especially hard-hit by the increase in housing costs and rents during energy development. Low-income housing programs of the Department of Housing and Urban Development (HUD), such as the Section 235 Program, limit loans to $32,000 for a three-bedroom home ($38,000 in high-cost areas) for families earning below the median income in the area.[2] Since average house prices are well above these limits in the West, as seen in Table 8-3, the program is of little benefit in energy-impacted areas.

In general, HUD is not oriented toward small towns. HUD's Community Development Block Grant Program, for example, is intended to develop housing and public facilities and services in neighborhoods and communities. However, the program is designed to commit 75-80 percent of its funding to cities over 50,000 population, and the remaining 20 percent tends to be obtained by places surrounding metropolitan areas. The program places little emphasis on the needs of rapid-growth areas,[3] and is receiving considerable political pressure to distribute an even greater proportion of funds to large, older cities, especially in the Northeast.[4] On the whole, congressional attention to housing has been oriented toward large cities (Senate) and national financial markets (House) due to committee structure (see box "The Housing Committees System").

This is borne out by the relatively low usage of HUD programs in energy impacted areas in the West. Only one program was used in Fiscal Year 1976, a loan program for the development of low- and moderate-income housing projects; and this program was used in only 7 of 75 impacted counties in the West. On a state-by-state basis, HUD funding in the West was below the regional share of federal aid for all programs (3.02 percent). Only Colorado received more than 3.02 percent, largely for the Denver area.[1]

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[1] Carlisle, N. "Boomtown Housing: The Problems and Possible Solution," in Bronder, L., N. Carlisle, and M. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977, p. 492. See also Schafer, R. "Housing in America." Technology Review, Vol. 80 (October/November 1977), p. 10.

[2] These are 1978 limits; they are raised periodically to meet rising housing costs.

[3] Carlisle. "Boomtown Housing."

[4] "House Seeks $14.5 Billion in Urban Aid." Denver Post, May 13, 1977, p. 5.

THE HOUSING COMMITTEES SYSTEM

Housing in rural areas and small towns is not a major focus of the existing congressional committees and subcommittees. In the Senate, housing is dealt with primarily by the Urban Affairs and the Subcommittee on Housing and Urban Affairs, which has no representatives from the eight western states. In the House of Representatives, the Committee on Banking, Currency, and Housing looks primarily at large-scale financial matters and the Subcommittee on Housing and Urban Development is oriented toward urban problems. Housing in small towns tends to be dealt with by committees responsible for agriculture or Indian affairs.

--Congressional Quarterly, Inc. Washington Information Directory 1977-78. Washington, D.C.: Congressional Quarterly, Inc., 1977.

The Farmers' Home Administration (FmHA) in the Department of Agriculture, on the other hand, is intended to deal with small towns and rural areas. Even though severe income limits are imposed on qualifications, FmHA programs are used in 71 impacted counties in the West.[2] Families with income not exceeding $15,600 can obtain a maximum loan of $33,000.[3] Most family incomes in energy-impacted communities are above the income limit, but the programs do assist families on fixed incomes in these communities.

The western states have been fairly active in attempting to provide conventional housing, but state housing financing authority is restricted to low or moderate income groups in all states.[1] Only Colorado has actually generated money through a sale of $50 million of bonds to be passed through lending institutions in rural areas. An additional $34 million of bonds have been sold to finance construction loans.[2] Montana's Board of Housing permits financing of low-income family housing only, but also takes into account "the ability of persons and families to compete successfully in the normal housing market," as well as the availability and cost of housing in particular areas.[3]

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[1] U.S., Department of Energy, Socioeconomic Program and Data Collection Office, Region VIII. Federal Aid Programs in Region VII for Fiscal Year 1976: Programs Available in Areas of Concern and the Usage of Such Programs by Energy Impacted Counties in Region VIII. Denver, Colo.: U.S., Department of Energy, 1977.

[2] Ibid.

[3] Carlisle, N. "Boomtown Housing: The Problems and Possible Solution," in Bronder, L., N. Carlisle, and M. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977, p. 489-90.

The Board put its first bond issue on the market in March of 1977. Thus, housing in impacted communities may be financed by the Board in the near future. New Mexico also has a state housing agency, but without special provisions for rural areas and small towns.[4] The state-owned Bank of North Dakota holds nearly $52 million in housing loans in a secondary mortgage market role, all under federal guarantee programs rather than conventional loans.[5]

C. Homebuilders and Developers

Considerations other than financing also are involved in housing market inadequacies in the West. Housing developers and builders have not been adequately meeting the needs of impacted towns for several reasons. Local builders frequently lack experience with large-scale developments and are not organized to manage them. Outside developers often reject smaller cities and towns as unsafe risks or as inadequate markets for large-scale projects (see box).

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[1] Carlisle, N. "Boomtown Housing: The Problems and Possible Solutions," in Bronder, L., N. Carlisle, and M. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977, pp. 494-505. Wyoming's widely publicized attempt to be involved in the secondary mortgage market, the Wyoming Community Development Authority (WCDA), has been declared unconstitutional by the Wyoming State Supreme Court. See Wyoming State Supreme Court Docket Number 4788, February 13, 1978. "Edwin J. Witzenburger, State Treasurer of the State of Wyoming, Appellant Defendant Below v. State of Wyoming, ex rel. Wyoming Community Development Authority, Appellee Below v. State of Wyoming (Intervenor Below)." 575 P. 2nd 1100.

[2] Carlisle. "Boomtown Housing."

[3] Montana Revised Codes Annotated § 35-503(8) (Cumulative Supplement 1975); Daley, J.B. "Financing Housing and Public Facilities in Energy Boom Towns," in Rocky Mountain Mineral Law Foundation. Rocky Mountain Mineral Law Institute: Proceedings of the 22nd Annual Institute, July 22-24, 1976. New York, N.Y.: Matthew Bender, 1976, pp. 119-20.

[4] Carlisle. "Boomtown Housing."

[5] North Dakota's Citizens Rely on State's Bank." Washington Post, January 8, 1978.

Housing construction also is difficult to maintain when inflated wages (from competition with energy firms which offer higher pay) make recruiting or keeping a skilled construction labor pool difficult and costly. The difficulty of hiring and the cost in wages constrain local firms from expanding. It also can cause out-of-town firms to stay away from energy-impacted communities where costs are higher than in major urban areas.[1]

SMALL CITY HOUSING DEVELOPMENT

Large housing development firms have tended to stay away from such towns as Rock Springs and Gillette, preferring towns the size of Casper, (pop. 40,000) or larger. Large-city based housing developers may simply have inadequate information about smaller towns and may see the expense of moving into a new market, becoming familiar with local conditions and recruiting local labor as too expensive. Once again, larger towns have the advantages of being somewhat better known and with greater local market potential.

--University of Denver, Research Institute, Industrial Economics Division. Methodology Papers: Housing. Denver, Colo.: Denver Research Institute, 1977.

The homebuilding industry consists largely of small firms that build homes primarily in their local area. A few large homebuilders account for about one-third of all new homes, but these are almost exclusively located in large metropolitan areas. Outside major urban areas, builders tend to operate within a fairly small area, such as part of a state. Local building codes, zoning regulations, labor markets, and union work rules frequently vary from area to area. More importantly, construction financing is usually obtained in the local area, and builders often have trouble obtaining loans outside their usual locus of operation.[2]

Housing developers also range in size with the largest operating in the large metropolitan areas. Developers generally centralize housing production on several sites. A developer, with the help of substantial financial backing, obtains land, subdivides it, paves streets, and installs utilities in preparation for building (Figure 8-2, Steps 2 and 3). The actual construction is then done by the developer, a single builder, or more commonly, by several local builders. Large-scale housing developments are still uncommon in western energy areas, remaining instead in the more profitable suburban areas of major cities. Large developers tend to be more connected to sources of financing in major cities, adding to the amount of financing available to developers. These large developers and their investors have not been operating in small towns, and small developers and builders have been unable or unwilling to take risks on speculative (as opposed to custom-built) homes.

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[1] University of Denver, Research Institute, Industrial Economics Division. Methodology Papers: Housing. Denver, Colo.: Denver Research Institute, 1977.

[2] This discussion of the homebuilding industry in general is taken from a paper prepared for this study by Arn Henderson and Daniel B. Kohlhepp of the University of Oklahoma.

D. Energy Industry

Several energy developers have taken actions to provide housing (primarily mobile homes) for construction worker families because of evidence of lower productivity, worker (or spouse) dissatisfaction, and increased labor turnover.[1] Firms tend to resist housing commitments in principle, generally on the grounds of cost and the fact that housing historically has not been their responsibility,[2] but the trend toward industry housing activity is clear.

Much of the housing provided has been planned mobile home developments, either on a temporary basis in a permanent subdivision removed from other towns (Atlantic Richfield's development of a mobile home park at Wright, 40 miles from Gillette, Wyoming) (see box "Wright Again"). Some commercial, social, and recreational amenities are included in such developments, but often not while construction workers' families are the only residents.[3]

Largely because of the preference of families for single-family housing,[4] permanent housing projects financed and planned by energy development companies are becoming more common in the West. The most comprehensive example is the new town of Colstrip, a company town owned by Montana Power Company. Older homes were modernized, and both single-family and multifamily units have been built, in addition to permanent mobile home spaces. A wide variety of urban amenities (recreation areas, commercial development, etc.) is also part of the "modern company town."[1] The company town approach is in some ways the ideal solution to housing shortages as well as to local impacts. The cost of building and operating such a town, however, is prohibitive for most firms, and there is little sentiment for repeating the Colstrip development in other areas.[2] Other firms have become involved in providing housing for their employees, especially in isolated, small towns in Utah and Wyoming. The common approach is to provide a guarantee to private developers for a certain number of homes. However, these developments typically include a preference for company employees.[3] As a result, construction

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[1] Metz, W.C. "Residential Aspects of Coal Development." Paper presented at the Conference of the American Institute of Planners, Kansas City, Missouri, October 1977; Jacobsen, J. "Coping with Growth in the Modern Boomtown." Personnel Journal, Vol. 55 (June 1976), pp. 288-89, 303.

[2] Arthur Young and Company. Problems of Financing Services and Facilities in Communities Impacted by Energy Resource Development. Washington, D.C.: Arthur Young, 1976.

[3] Mobile homes are discussed at greater length in Section 8.3.2 below.

[4] Mountain West Research. Construction Worker Profile, Final Report. Washington, D.C.: Old West Regional Commission, 1976, p. 103.

WRIGHT AGAIN

Wright, Wyoming, has reappeared on the map after a 40-year absence. A ranch house post office closed its doors during the Depression, but the name has been given to a mobile home park for employees of ARCO's Black Thunder Mine 40 miles south of Gillette. By living closer to the mine than they would have in Gillette, the only town in Campbell County, workers will commute shorter distances. But this alternative has been at considerable cost to ARCO. The telephone system which cost $600,000 would have cost ARCO nothing in Gillette. Families still must drive to Gillette for shopping and other services.

--"Town Revived in Coal Boom." Denver Post, July 13, 1976; and Enzi, Michael, Mayor of Gillette. Personal communication.

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[1] Myhra, David. "Colstrip, Montana--The Modern Company Town." Coal Age, Vol. 80 (May 1975), pp. 54-57; Schmechel, W.P. "Developments at Western Energy Company's Rosebud Mine," in Clark, W.F., ed. Proceedings of the Fort Union Coal Field Symposium. Billings, Mont.: Eastern Montana College, Montana Academy of Sciences, 1975, Vol. 1, pp. 60-66; White, M. "Colstrip Power Project--Its Monitoring and Mitigation Programs." Paper presented at the Symposium on State-of-the-Art Survey of Socioeconomic Impacts Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977.

[2] Arthur Young and Company. Problems of Financing Services and Facilities in Communities Impacted by Energy Resource Development. Washington, D.C.: Arthur Young, 1976.

[3] Metz, W.C. "Residential Aspects of Coal Development." Paper presented at the Conference of the American Institute of Planners, Kansas City, Missouri, October 1977.

workers, who are usually employed by a construction contractor, and service workers in nearby towns are not aided by these actions.

Finally, some state actions involve working with private industry to alleviate energy development impacts. The Wyoming Industrial Siting Administration (WISA) issues a siting permit for major facilities only after studies and hearings with state agencies and the local community provide information on the conditions to be placed on the permit.[1] In the only permit processed by late 1977, Basin Electric Power Cooperative agreed to provide approximately 1,900 housing units and other services in connection with its power plant near Wheatland.[2] This may not be a precedent-setting case, however, because Basin Electric, as a co-op, is able to include impact mitigation costs in its rate base, something investor-owned utilities typically cannot do.[3]

In summary, the private housing market is not working well in the West; and current government programs are not having a significant effect. Industry is beginning to take a role in providing housing for their employees, but housing demands of other workers remain unmet. The usual solution is mobile homes (see box "Boomtown Housing"), which are discussed in the next section.

8.2.2 Housing Quality

Concern about housing quality in western towns affected by energy development centers on mobile homes. The lack of single-family homes and multifamily units in most towns has forced the majority of new families to live in mobile homes. This is true even where energy firms have provided some housing for their employees. In such cases, local service workers such as local government and retail employees, do not have an alternative to mobile homes. In other cases, where mobile homes are provided for construction workers, there is little choice of other housing for those who want it. This trend runs counter to the preferences of the families both of new construction workers and other newcomers to the West. In addition, although rising home prices have constrained preferences in most parts of the country, incomes in western towns are well above the national average,[1] suggesting that income is not the reason for poor housing conditions. Overall, residents of western towns in energy-impact areas have less choice in housing than residents elsewhere in the nation.

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[1] Industrial Development Information and Siting Act of 1975, Wyoming Statutes §§ 35-502.75 et seq. (Cumulated Supplement 1975).

[2] Wyoming Industrial Siting Administration, Docket Number WISA-75-3. See also Valeu, R.L. "Financial and Fiscal Aspects of Monitoring and Mitigation." Paper presented at the Symposium, on State-of-the-Art Survey of Socioeconomic Impacts Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977.

[3] Since the WISA has no jurisdiction over facilities valued at less than $50 million, nearly all coal mining operations have typically not been subject to the Act's provisions. However, local governments have recently succeeded in having surface facilities associated with coal mines included in the valuation, thereby raising the value of facilities to at least $100 million and bringing them within the Siting Authority's jurisdiction. Enzi, Michael. Personal communication, April 24, 1978.

BOOMTOWN HOUSING

"During the Sweetwater County, Wyoming, boom's early stages, the housing stock of the county was approximately doubled with 6,000 new units. Fifty-five hundred of these were mobile homes... The housing market demand drove prices and rents up, yet investors and developers were skeptical of putting money into boomtown housing. Even if they had been willing, mortgage money was not available for the typical miner wishing to buy a home. This same pattern is reproduced in most boomtowns. Even when mining or utility companies bring housing into being, little or no provision is made for the local service workers who must also be accommodated in a fast growing community."

--Gilmore, John S. Prepared Statement in U.S., Congress, Senate, Committee on Environment and Public Works. Inland Energy Development Impact Assistance Act of 1977, Hearings before the Subcommittee on Regional and Community Development, 95th Congress, 1st session, August 2 and 27, 1977, pp. 266-67.

This section outlines several aspects of the housing quality problem. The first part deals with mobile homes and their role in present western housing. The second topic discussed is that of other housing choices available to families in impact communities. The last part of this section discusses housing on Indian reservations in the West.

A. Mobile Homes

Mobile homes are a common solution for problems of inadequate housing supply in the West.[2] Mobile homes fill a useful need for temporary residents during energy facility construction periods. Construction always requires some short-term workforce; the fact that residents who are not involved in construction also have no alternative to mobile homes attests to overreliance on this housing type.

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[1] See Mountain West Research. Construction Worker Profile, Final Report. Washington, D.C.: Old West Regional Commission, 1976, pp. 46-51 and 103.

[2] Zelenski, C., and J. Cummings. Low to Moderate Income Housing Need in the State of Wyoming. Cheyenne, Wyo.: Wyoming Department of Economic Planning and Development, 1977; U.S., Federal Energy Administration, Region VIII, Socioeconomic Program Data Collection Office, Regional Profile: Energy Impacted Communities. Lakewood, Colo.: Federal Energy Administration, 1977.

The overuse of mobile homes has been generally unsatisfactory to both residents and local governments. In many cases, the homes in a development are placed very close together, yards are small or nonexistent, and paved streets are rare. Those living in mobile homes often find them small, poorly constructed, depreciating in value, or simply possessing an aura of shabbiness.[1] In the words of a Gillette, Wyoming, resident: "Mobile home parks can be nice places to live unlike the slums ours have turned out to be."[2] In company-provided, employee-only mobile home developments, the social segregation from other townspeople also creates dissatisfaction.[3]

Mobile home development takes place in a manner similar to the single-family home development process outlined in Figure 8-2. A developer still must go through the required development steps, but the only construction usually required is a concrete pad and utilities for each mobile home. Mobile home park developers frequently retain ownership of the park, and lease individual lots to mobile home owners. It is uncommon for mobile home residents to own the lot they occupy, although some mobile home owners buy small rural lots on which to put their mobile homes.

The method of financing mobile homes contributes to residents' dissatisfaction with this housing type. Except in Wyoming, the customary loan practice is to finance them as personal property (like automobiles), rather than real property. Interest rates, therefore, are substantially higher (by 2 to 3 percent) for mobile homes than for home mortgages, which currently average around 9 to 9 1/2 percent. Down payments range from 10 to 40 percent, which still requires a large initial sum on a $15,000 unit.

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[1] McKown, C. "Personal and Social Acceptance of Manufactured Homes and Other Innovations," in Quality Housing Environment for Rural Low-Income Families, Bulletin Y-102. Muscle Shoals. Ala.: Tennessee Valley Authority, National Fertilizer Development Center, 1976, pp. 75-77; Luxenberg, S. "Mobile Homes Growing Up." New York Times, May 22, 1977, pp. 1, 9.

[2] Pernula, Dale. City of Gillette/Campbell County: 1977 Citizen Policy Survey. Gillette, Wyo.: Gillette/Campbell County Department of Planning and Development, 1977, p. 34.

[3] Fradkin, P.L. "Craig, Colorado: Population Unknown, Elevation 6,185." Audubon, Vol. 79 (July 1977), pp. 118-27; University of Montana, Institute for Social Science Research. A Comparative Case Study of the Impact of Coal Development on the Way of Life of People in the Coal Areas of Eastern Montana and Northeastern Wyoming. Missoula, Mont.: University of Montana, Institute for Social Science Research, 1974.

Designating mobile homes as personal property and separating them from the land has two other important effects. First, mobile homes tend to depreciate rather than increase in value over time as conventional home/lot combinations do. Second, they are not taxed as real property, and local governments can tax only the value of the land. The tax revenue, therefore, is well below that for a home-lot combination. Further, the property owner is the legal landowner, and residents pay no property tax directly.[1]

These legal and financial aspects of mobile homes often lower their desirability in the eyes of local governments. Little revenue is added to the tax rolls and the high density of mobile home parks also conflicts with aesthetic values. As a result, they are usually restricted by zoning to less desirable areas of towns or banned entirely.[2] Housing demand, however, still tends to be met by mobile homes. Although municipal zoning often is not very stringent, in some states there is a little or no land-use and zoning control in unincorporated county areas.[3] Mobile home parks clustered near a town's edge and along highways have become a common sight in much of the West since energy development began on a large scale in the early 1970's.[4]

Other local government actions can affect the location of housing. In an attempt to get some much-needed revenue and to make new developments self-supporting, many towns have instituted large utility tap fees and donation of park land and other facilities on new housing development. Water and sewer tap or hookup fees run as high as $2,000 per unit in Gillette, Wyoming. Developers who want to avoid these costs need only develop land outside of town, as ARCO and Kerr-McGee have chosen to do in the Campbell County area of Wyoming.[1]

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[1] In some retirement-type mobile home parks, this legal separation of home from land does not take place. However, in the West and much of the rest of the country, the situation is as described here. See, for example, Luxenberg, S. "Mobile Homes Growing Up." New York Times, May 22, 1977, pp. 1, 9.

[2] Ibid.

[3] The question of zoning and land use control is discussed at greater length in Chapter 9.

[4] Federal Interagency Team. The Energy Boom in Southwest Wyoming. Washington, D.C.: U.S., Department of Housing and Urban Development, 1976.

Federal government programs concerning mobile homes have little positive effect on the housing situation in western towns. Mobile home construction and safety standards have upgraded the quality of the units in the manufacturing stage.[2] The quality issues that remain are those of mobile home park design. Spacing, distance from street, and utility hookups are specified criteria for FHA insured loans.[3] Conventional loans are usually used to develop mobile home parks in the West; therefore, the federal standards are meaningless in practice.

State standards are able to supplement the lack of other regulations. Of the eight states in this study, only Montana and North Dakota have guidelines for mobile home park design, and only Montana has a mobile home park code that is enforced at the local level by a representative of the state government.[4] In the other western states, mobile home park regulation is left to local governments, as discussed above.

B. Housing Choices

The ability to choose among a variety of housing alternatives is one measure of housing quality. The lack of choices in the West results in part from the financing conditions that constrain single-family housing (described in Section 8.2.1 above) and the resultant heavy reliance on mobile homes. Choices other than those two, such as apartments, townhouses, condominiums, and various modular designs are discussed briefly here.

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[1] Metz, W.C. "Residential Aspects of Coal Development." Paper presented at the Conference of the American Institute of Planners, Kansas City, Missouri, October 1977.

[2] The regulations include standards on lighting, interior space, bathroom locks, plumbing, electrical systems, among other items. See 40 Fed. Reg 40260-303 (September 2, 1975); 41 Fed. Reg. 48752-92 (December 18, 1975); 42 Fed. Reg. 960-66 (January 4, 1977).

[3] U.S., Department of Housing and Urban Development, Office of Community Planning and Development. Rapid Growth from Energy Projects: Ideas for State and Local Action, A Program Guide. Washington, D.C.: Government Printing Office, 1976.

[4] Rapp, Donald A. Western Boomtowns, Part I, Amended: A Comparative Analysis of State Actions, Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, p. 19. The existence of state guidelines is no guarantee that they are even publicized at the local level. For example, local officials in Mercer County, North Dakota, have no record of the North Dakota guidelines (personal communication, May 1977).

Apartment developments are not yet common in energy-impact communities for two principal reasons. First, they involve a sizable investment (about $30,000 per two to three bedroom unit) that would be difficult to obtain construction financing for in small towns. In larger towns, the larger population, including many residents from large cities where apartments are common, attract some investment in apartments. For example, some apartment development is being financed or guaranteed by energy companies but, as with single-family housing, priority is given to company employees.[1] Second, typical monthly rents for apartments, where they are available, are rather high (Table 8-3), especially in comparison with mobile homes. Apartments are being built in larger towns, such as Gillette and Farmington where the population meets conventional market thresholds. In smaller towns, (under 15,000 population) multifamily housing is scarce if not impossible to find.

Modular or factory-built wood-frame housing, is becoming a major source of single- and multifamily housing in the West, particularly in larger towns. Relatively little labor is needed to set modular homes on their foundations, which reduces, but does not eliminate, the need for skilled workers to finish them on-site. In most towns, the cost of modular housing is about the same as the cost of houses constructed on-site (about $55,000 in 1976 for a 1,100 square-foot house in Gillette). Land costs, local wage levels, subdivision and development costs (such as utility connections), and financing are the same for both types.[2]

Much of the cost advantage of modular units is lost in transportation costs, which average $4.50 to $5.00 per mile for each unit.[3] Cities and rural areas not on a rail line or an interstate highway (such as Farmington, New Mexico and southern Utah) face even higher delivery cost and delays in delivery over inadequate roads.

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[1] Metz, W.C. "Residential Aspects of Coal Development." Paper presented at the Conference of the American Institute of Planners, Kansas City, Missouri, October 1977.

[2] Federal Interagency Team. The Energy Boom in Southwest Wyoming. Washington, D.C.: U.S., Department of Housing and Urban Development, 1976, p. 4.

[3] Kaiser Engineers. Kaiser Coal Project, Interim Report June 30, 1975, Vol. 6: Community and Public Relations (Area D) Oakland, Calif.: Kaiser Engineers, 1975, Section X.

Employee barracks are another housing option that is being used in the West, principally for construction workers who do not have their families with them. For example, the Wyodak power plant project being built by Pacific Power and Light near Gillette uses prefab quarters for unmarried workers. Many men work a five day week and drive hundreds of miles to their homes and back each weekend.[1] Living conditions in such quarters, however, can be unsatisfactory to some workers.[2]

C. Indian Housing

Housing on Indian reservations raises several problems that are somewhat different from those discussed above. In addition to a housing shortage, the principal problem is one of quality; for example, the lack of plumbing and crowding large families in small quarters.[3] Table 8-4 presents some indication of the Indian housing situation in the West, including the Navajo Reservation, where housing needs are most severe. As energy development proceeds on and near Indian lands, developers will be under pressure both to employ Indians and to contribute to improvements in the Indian housing situation. A Navajo "New Town" proposal related to energy developments on the Navajo Reservation was, to some degree, a response to this pressure by firms proposing coal gasification projects, but most of the financing arrangements were left to the Navajo Tribe.[4]

Mobile homes are becoming common on Indian reservations, even in areas where water is not available, and this trend is likely to continue. Few houses in the Four Corners area,

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[1] "Wyoming Grassland Transformed to Coal Mining Center." Civil Engineering - ASCE, September 1977, pp. 50-56.

[2] "Public Utility's Work Barracks Criticized," Denver Post, November 1, 1976.

[3] Navajo Tribe, Office of Program Development. The Navajo Nation Overall Economic Development Plan. Window Rock, Ariz.: The Navajo Tribe, Office of Program Development, 1974, pp. 48-49; U.S., Department of the Interior, Bureau of Indian Affairs, Billings Area Office. Final Environmental Statement: Crow Ceded Area Coal Lease, Tracts II and III, Westmoreland Resources. Billings, Mont.: Bureau of Indian Affairs, 1976, pp. II-131 to II-134.

[4] Morrison-Knudsen Company. Navajo New Town Feasibility Overview. Boise, Idaho: Morrison-Knudsen, 1975.

TABLE 8-4: HOUSING CONDITIONS OF INDIANS IN THREE WESTERN REGIONAL BUREAU OF INDIAN AFFAIRS AREAS, 1973

CONDITION	BIA AREA OFFICE		
	BILLINGS	NAVAJO	ALBUQUERQUE
Total Number of Families[a]	6,071	23,801	8,349
Number of Standard Units	3,335	3,126	3,180
Number of Substandard Units	2,269	19,242	2,841
Families Doubled Up	467	1,433	2,328
Total Need as Percent of Families	45.1	86.9	61.9
New Units Needed	1,861	7,324	3,332
Rehabilitations Needed	875	13,351	1,837

BIA = Bureau of Indian Affairs

Source: U.S., Congress, Senate, Committee on Interior and Insular Affairs. Indian Housing in the United States, A Staff Report on the Indian Housing Effort in the United States with Selected Appendices. Washington, D.C.: Government Printing Office, 1975, p. 3.

[a] Indian families only.

particularly on the Navajo Reservation, have running water,[1] and few towns have sewer systems. Tribal housing developments with running water will probably be able to provide only a small fraction of new homes for Indians.

A further energy development problem concerns employing both Indians and non-Indians. Individual land ownership is commonly prohibited on reservations. This is the case, for example, on the Navajo Reservation, the largest Indian reservation in the West. Therefore, conventional residential and commercial developments are not possible.[2] Thus, non-Indians tend to settle in nearby towns, while Indians tend to live in mobile homes and substandard housing scattered throughout the reservation.

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[1] U.S., Department of the Interior, Bureau of Indian Affairs, Planning Support Group. Draft Environmental Impact Statement: Navajo-Exxon Uranium Development. Billings, Mont.: Bureau of Indian Affairs, 1976, pp. II-89 to II-93.

[2] U.S., Commission on Civil Rights. The Navajo Nation: An American Colony. Washington, D.C.: Commission on Civil Rights, 1975, p. 19.

Partly because of the land ownership situation and partly because of low incomes among Indians, nonsubsidized housing projects are rare. Even though all western Indian reservations would meet the criteria for FmHA programs, Indians account for less than one percent of all FmHA loans.[1] According to the Housing Assistance Council, this is largely due to a lack of knowledge about the programs, even though they may be more flexible and potentially helpful to Indians than are HUD and Bureau of Indian Affairs (BIA) programs.[2]

Other federal programs pertaining specifically to Indian housing are divided primarily among three agencies (HUD, BIA, and Indian Health Service), all of which play some part in any federally-funded housing project. Several tri-agency "Memoranda of Understanding" were signed during the 1960's to coordinate interagency efforts in Indian housing.[3] However, these Memoranda "have never been entirely successful because they lack any means of enforcement."[4] Another view cites "the near total lack of interagency coordination."[5] Since these complaints were noted, an Indian Desk has been established within HUD to consolidate agency efforts with respect to Indians. However, delays often result because Indian tribes have to deal with three federal agencies for a single project, whereas non-Indian local governments need only work with HUD. Among them, the three agencies have provided a number of water supply and sewer improvements and extensions on the Navajo reservation.[6]

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[1] U.S., Congress, Senate, Committee on Interior and Insular Affairs. Indian Housing in the United States, A Staff Report on the Indian Housing Effort in the United States with Selected Appendices. Washington, D.C.: Government Printing Office, 1975.

[2] Housing Assistance Council. A Guide to Indian Use of Farmers Home Administration Housing Program. Washington, D.C.: Housing Assistance Council, 1976.

[3] These memoranda are reprinted in Senate Committee on Interior and Insular Affairs. Indian Housing.

[4] Ibid., p. 12

[5] Ibid., pp. 169-78 (quote on p. 173).

[6] Navajo Tribe, Office of Program Development. The Navajo Nation Overall Economic Development Program, 1976 Annual Progress Report. Window Rock, Ariz.: The Navajo Tribe, Office of Program Development, 1976, pp. 46-48.

8.2.3 Summary

The housing problem in western communities with new energy development is one of both quantity and quality. The quantity of housing is in short supply because of the constraints in financing in the private housing market. Energy development involves uncertainties about long-term housing demand, and these uncertainties have resulted in a very low level of local construction lending. Local lending institutions in the West generally are not linked effectively to the national housing financing system, the secondary mortgage market. Energy developers have provided some housing in larger towns for their employees, but a shortage of home construction prevails throughout the areas affected by energy development.

No federal programs are specifically designed to deal with housing shortages in rapid-growth areas such as the West. State actions, like federal programs, have little effect in energy areas, because of an orientation toward low-income families in urban areas. Federal actions have been more effective at improving the quality of housing on Indian reservations in the West. However, a lack of coordination of Indian housing programs is blamed for slow progress in improving the Indian housing situation.

In the absence of adequate public or private market response to housing demand, mobile homes have become the housing type for the majority of newcomers to energy-impacted western towns. These provide little property tax benefit to local governments because the homes are bought and owned as personal property. Partly as a result of this, mobile homes are often restricted by local zoning regulations to less desirable parts of town. In most areas, mobile home developers can avoid zoning restrictions completely on unincorporated land outside of municipal boundaries, and mobile home parks that cluster on town edges are generally low in quality. Few towns have any other housing choices, such as apartments and townhouses.

8.3 ALTERNATIVE POLICIES AND IMPLEMENTATION STRATEGIES FOR HOUSING

8.3.1 Introduction

Discussion in the two preceding sections led to the conclusion that the shortage and quality of housing, particularly in small, isolated western communities, is a major problem affecting energy resource development in the West. Policies for dealing with this problem can attempt to achieve one or more of the three objectives listed in Table 8-5, to:

- Reduce the peak demand for temporary housing;

TABLE 8-5: OBJECTIVES AND ALTERNATIVE POLICIES FOR HOUSING

POLICY OBJECTIVE	CATEGORIES OF ALTERNATIVES	SPECIFIC ALTERNATIVES
To reduce the peak demand for temporary housing	Decrease the number of workers living on-site	Adjust project schedules
		Long distance commuting
		Siting based on technological/ locational factors
To increase the quantity of housing financing and construction through the private market	Increase the quantity of housing construction	Make state siting permits conditional on housing provisions
		Stimulate industry investment in housing
	Increase the availability of construction and home mortgage financing	Government guarantees in the secondary mortgage market
		Grants and loans to builders and developers
To improve housing quality	Diversify housing mix	Financial assistance for lenders and developers of apartments, condominiums, and townhouses.
		Tax incentives for rental housing
	Improve the mobile home situation	Change financing and tax structure for mobile homes
		Develop quality mobile home parks
		Institute local land-use controls for all areas of a county

- Utilize the existing private housing market to increase the availability of housing financing and the numbers of houses being constructed;

- Improve the quality of housing.

These three objectives are not necessarily mutually exclusive; for example, decreasing demand for temporary housing and increasing the amount of new housing available would presumably contribute to an overall improvement in housing quality in energy-impacted communities.

This section identifies several possible alternative policies and implementation strategies for achieving these three policy objectives. An underlying assumption is that, although federal and state programs may provide secondary mortgage market support, the private mortgage market will continue to be the principal mechanism for financing both construction and home mortgages. We also assume that the preference of most families for single-family homes will continue to be a major consideration in dealing with the housing problems which arise in energy-impacted western towns.

A. What Are the Alternatives?

The categories of alternatives to be considered to achieve each objective are shown in Table 8-5. For example, the first objective, to reduce the peak demand for temporary housing, is addressed by policy alternatives that would decrease the number of workers living at or near energy development sites in the West. Two categories of alternatives responsive to the second objective, increasing the quantity of housing financing and construction available through the private market are to: (1) increase housing construction, and (2) increase the availability of financing for construction and home mortgages. For the third objective, improving housing quality, two categories of policy alternatives could contribute to achieving the objective: (1) diversifying the housing mix, and (2) improving the mobile home situation. Specific alternatives within each of these categories are listed in Table 8-5. The five categories of alternatives and the specific alternatives within each category are briefly described in the following section.

(1) Decrease the Number of Workers Living On-Site

This category of alternatives is intended to reduce the number of temporary workers who would otherwise move into the local community from outside the impact area and require housing. Adjusting project schedules will reduce the size of the temporary population living in an energy development area at any given time.

For example, the construction of a coal gasification facility usually takes about five years and requires more than 4,600 workers during peak construction activity, and the impacts are compounded when two or more facilities are constructed simultaneously.[1] Peak construction labor requirements could be reduced to about 2,600 workers if the construction schedule were lengthened to eight years.[2] This would reduce the severity of the impact of energy development on local housing.

Regardless of the construction schedule established for an energy project, the peak demand for temporary housing in the local area can be reduced if the number of workers who live near the construction site is kept to a minimum. The second specific alternative suggests that workers be encouraged to live in larger population centers in the region and commute to construction sites, either individually, or in carpools and buses.

Since the peak employment during the construction phase depends upon the technology of the facility, the third specific policy option focuses on achieving the best possible combination of technologies and locations to reduce the peak demand for temporary housing. For example, a coal gasification plant requires about 25 times as many workers during the peak employment period as does a surface coal mine.[3] This approach to resolving the housing problem proposes that policymakers consider siting strategies which place facilities requiring a large temporary labor force in less isolated areas which have a large enough population base to accommodate the population influx which energy resource development will bring. This option could also lead to siting some energy facilities near load centers outside of the western region.[4]

(2) Increase the Quantity of Housing Construction

This is the first of two categories of policy alternatives that respond to the second general objective of increasing the number of houses being constructed. It includes specific options involving industry or industry/government actions to increase the level of private sector homebuilding activity in energy-impacted communities, and assumes that energy industries should bear part of the cost of providing housing for their workers.[1]

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[1] Carasso, M., et al. The Energy Supply Planning Model, Vol. I. San Francisco, Calif.: Bechtel Corporation, 1975, pp. 6-30 through 6-31.

[2] Ibid.

[3] Ibid.

[4] Problems and issues of energy facility siting are discussed in more detail in Chapter 12.

Facility siting legislation in some states stipulates that siting permits may be made conditional on an industry's agreeing to mitigate impacts likely to result from the construction and operation of the proposed facility. However, state siting laws have other objectives in addition to dealing with socioeconomic or population growth-related impacts, such as balancing environmental and energy development concerns. In some states with such legislation, public sector impacts are addressed, but there is no capability for avoiding private sector impacts such as housing. In contrast, the alternative considered here is intended to deal with housing impacts in the manner of the Wyoming Industrial Siting Authority. For example, after studies and hearings, Basin Electric Power Cooperative agreed to furnish 1,900 housing units and other services to help mitigate the impacts of its proposed facility in Wheatland.[2] Similar requirements could be included in legislation in other states, or could be included in federal siting legislation.

Whereas impact mitigation requirements in state siting legislation could compel companies to provide housing for their workers, the second alternative, stimulating industry investment in housing, relies on industry to take the initiative by investing in housing in the local communities that will be affected by the proposed facility. In the past, companies taking this kind of initiative provided mostly mobile homes; however, the company's activities in providing housing could range from building and operating an entire town, as Montana Power did in Colstrip,[1] to working with private developers to guarantee financing for a specified number of homes.

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[1] Providing ample quality housing may contribute to worker satisfaction and help to stabilize the workforce. See Richards, W. Robert. "Mining Industry Housing and Community Relations." Paper presented at the American Mining Congress Coal Convention, St. Louis, Missouri, April 1978.

[2] Wyoming Industrial Siting Administration, Docket Number WISA-75-3. See also Valeu, R.V. "Financial and Fiscal Aspects of Monitoring and Mitigation." Paper presented at the Symposium on State-of-the-Art Survey of Socioeconomic Impacts Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977.

(3) Increasing the Availability of Construction and Home Mortgage Financing

Although housing financing in the U.S. has traditionally been the responsibility of the private sector, uncertainties associated with energy development in the West have made savings and loan associations and government agencies and insurance companies in the secondary mortgage market unwilling to provide loans for housing development in boomtowns. Federal housing programs currently available through the HUD are designed to deal primarily with metropolitan problems. Many western states now have a state financing authority; but, without exception, the authority's activity is restricted to low or moderate income groups. The housing assistance programs considered in this alternative might overcome the difficulties mentioned above by setting up state and/or federal housing financing quarantees in the secondary mortgage markets. This assistance, provided by federal funds or from state land and mineral revenues, could be used to back local lending institutions and finance construction loans.

(4) Diversify the Housing Mix

This is one of two categories of policy alternatives that seek to improve the quality of housing in energy-impacted communities in the West. As mentioned in Section 8.2.2, both single-family homes and multifamily units are in short supply in most smaller western towns, and there are a disproportionate number of mobile homes. The specific alternative in this category would encourage the construction of alternative housing types, such as apartments, condominiums, and townhouses, both by providing housing finance assistance to lenders and developers, and tax incentives to both developers and renters to encourage a wider range of choices.

(5) Improve the Mobile Home Situation

Even if policymakers are successful in diversifying the housing types available in western boomtowns, mobile homes will still remain the predominant housing type in the short to midterm future, especially for construction workers who live in the area only temporarily. Therefore, this category of policy alternatives is basically aimed at improving the quality of mobile home housing.

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[1] Myhra, David. "Colstrip, Montana--The Modern Company Town." Coal Age, Vol. 80 (May 1975), pp. 45-57; White, M. "Colstrip Power Project--Its Monitoring and Mitigation Programs." Paper presented at the Symposium on State-of-the-Art Survey of Socio-economic Impacts Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977.

The first specific policy alternative calls for improving the quality of mobile home housing by changing their tax status, and thereby, the way in which they are financed. Mobile homes are generally not classified as real property in the western states. This specific policy alternative calls for mobile homes to be reclassified as real property. This would make them eligible for lower interest loans; it could also lower their depreciation rate over time (they might even appreciate in value) and enable local governments to derive property tax revenues that could be used to finance local services and facilities.

The general undesirability of mobile homes has restricted their location to high-density developments in less desirable parts of town or in fringe locations immediately outside of municipal jurisdictions. The last two specific policy alternatives considered are designed to address these problems by controlling the way in which mobile home parks are developed and by instituting local land-use controls for all areas of the county to ensure that they cannot escape this control. Mobile home parks could be developed so that there is less congestion and more open areas, and so that the parks have many of the amenities usually associated with residential lots, such as paved streets and neighborhood parks. The same standards can be enforced in the surrounding county by adopting a local land-use law that applies to all areas of the county.

B. How Can the Alternatives Be Implemented?

Many of the policy alternatives briefly described above can be implemented in several different ways. Implementation strategies for each of the categories of housing alternatives are identified in Table 8-6. This table illustrates specific alternatives available to the policymakers, shows the specific strategy that can be used to implement the alternative, and calls attention to political, economic, and social factors that are likely to constrain implementation. Each will be discussed in more detail in the evaluation of alternatives in Section 8.3.2.

The alternative strategies presented here are intended to preserve the private mortgage market as the major mechanism for providing home mortgages and construction financing. Federal and state involvement is designed to lend support to the private sector by loan guarantees in the secondary mortgage market. The role of the private sector is also evident in those policy alternatives which seek to reduce the peak demand for temporary housing by extending the construction schedule for an energy project over a

TABLE 8-6: IMPLEMENTATION STRATEGIES FOR HOUSING

ALTERNATIVE	IMPLEMENTATION STRATEGY	CONSTRAINT
Adjust project schedules	Include requirement in state siting law and regulation	Industry reluctant to delay construction Higher construction costs Would require close cooperation and coordination among developers and with public agencies
Long distance commuting	Developer sponsored transportation provided by developers or subsidized by government Require or provide incentives for carpooling	Long commuting time Workers prefer their own vehicles
Technological/locational siting	Require or encourage labor-intensive facilities to be sited in more densely populated areas	Resources may not be located at these sites and may be too costly to move Existing environmental quality in more densely populated areas may make this undesirable
Require energy company to provide housing or guarantee financing	Make state siting permit conditional on provision of housing and/or Amend state utility pricing law to allow pass-through of costs	Law does not allow utility to pass costs to consumer
Stimulate industry investment in housing	Provide tax incentive to spur investment	Current tax law contains disincentive
Provide government assistance for housing in impact areas	Grants and loans for builders and developers Loan guarantees through state housing programs	Local financial institutions not linked effectively to secondary mortgage markets
Tax incentives for rental housing	Tax credit or exemption	Current tax law contains disincentive
Change financing and tax structure for mobile homes	Classify mobile homes as real property	State and/or local laws must be changed
Develop quality mobile home parks	Enact zoning law Adopt mobile home code with developer cooperation City acquisition of mobile home parks	No uniform standards for mobile home parks between city and county
Institute local land-use controls for all areas of a county	Designate acceptance sites for mobile home parks Set standards for development of mobile home parks	No uniform standards for mobile home parks between city and county

longer period of time or by encouraging workers to commute from larger population centers. Energy developers can also provide workers with incentives to commute, or they can organize mass transportation (e.g., buses) between population centers and energy development sites. Another facet of private sector involvement in this area is to have developers provide housing for their workers.

Facility siting laws would give the states a major role in housing assistance. The permit approval process enables the state to extract a promise of housing assistance from the developer to mitigate the impacts of the proposed facility. The state also plays a role by providing housing assistance in the secondary mortgage market.

The role of local government is important in housing policy, especially in achieving the third objective, "to improve the mobile home situation." Municipal regulation of mobile home development has often been ineffective because counties in the western states generally do not regulate mobile home development. Thus, residents are able to locate in crowded areas on the edges of towns or along the roads leading into towns, since there are no land-use regulations governing their activity. Cooperation between municipal and county government will be important in order to enforce land-use legislation, zoning laws, and mobile home codes.

8.3.2 Evaluation of Alternatives

A. Introduction

Since it is not possible to discuss all of the alternatives described above, two categories of alternatives which address particularly important aspects of the housing problem are evaluated and compared: decrease the number of workers living on-site, and increase the quantity of housing construction.

The five basic criteria identified and defined in Chapter 3 are used in this evaluation: effectiveness, efficiency, equity, flexibility, and implementability. Table 8-7 defines each criterion as it is applied specifically to housing problems and issues, and based on the policy objectives defined above (Section 8.3.1). As applied to the issue of housing, the criteria listed in Table 8-7 address two general questions. The first is whether the demand for housing in the West can be reduced. The second focuses on whether specific alternatives can be implemented and whether they are adaptable to changing demands for housing.

B. Evaluation of Decreasing the Number of Workers Living On-Site

Three specific policy alternatives for decreasing the number of workers living at energy development sites in the West are evaluated and compared in this section:

TABLE 8-7: EVALUATION CRITERIA AND SPECIFIC MEASURES FOR HOUSING POLICY

CRITERIA	AS APPLIED TO HOUSING	MEASURES
Effectiveness Are the objectives achieved?	Avoid or mitigate housing shortages? How many new units? Temporary or permanent housing, or both?	Quantitative: number of homes reduction in demand Qualitative: increase in quality
Efficiency What are the costs, risks, and benefits?	What are the economic costs of the option? What is the risk of loss or failure? What are the benefits to residents?	Quantitative: dollar cost risk probabilities availability of housing decrease/increase in worker productivity
Equity What is the distribution of costs, risks, and benefits?	Who bears the costs and risks? Who gains from the policy option? Are some regions of the country dealt with differently than other regions? How are preferences and demands for housing types met?	Qualitative: costs -- who pays? benefits -- who gains? risks -- who bears risks?
Flexibility[a] How flexible is it?	Are regional differences in housing needs considered? Are existing housing market mechanisms utilized or are new ones added? Do firms have a choice of using this option or is it mandated?	Qualitative: adaptability adjustability
Implementability Can it be adopted?	Are industry initiatives an important part of the option? Is government subsidy and control kept to a minimum? Are both public and private interests involved in the alternative?	Qualitative: changes required parties involved

[a] On flexibility in housing programs, see Struyk, R.J. "The Need for Local Flexibility in U.S. Housing Policy." Policy Analysis, Vol. 3 (Fall 1977), pp. 471-83.

- Adjustment of project schedules;
- Long distance commuting;
- Consideration of technological/locational factors in siting.

The principal objective to be achieved by this category of policy alternatives is to reduce the overall need for temporary housing during energy facility construction. The strain on local housing markets caused by short-term construction workers affects all residents of a rapidly growing town, especially if some construction workers choose to live in some of the town's permanent housing. This may force a permanent resident to live in a mobile home or similar housing. The alternatives discussed below attempt to reduce the number of temporary workers from outside the impact area who would otherwise move into the area and demand housing.

The principal responsibility for implementing these alternatives would rest with private industry, acting in concert with state and local officials. Implementation strategies considered for this set of policies include:

- Enacting state siting laws with provisions that would make siting permits conditional on industry providing adequate housing for the workers it expects to employ in the new facility;
- Providing incentives for employees to live in larger population centers further away and commute to the energy construction site;
- Siting of labor-intensive energy facilities, such as conversion plants in more densely populated areas, in order to minimize or avoid the impact on small, isolated communities in the West.

The success of each policy alternative will depend upon the particular implementation strategy that a policymaker pursues. The choices presented here do not exhaust the range of policies that might be adopted to reduce the peak demand for temporary housing. However, an evaluation of the three alternatives that are presented here will inform policymakers about the trade-offs that are associated with various specific policy alternatives.

(1) How Much New Housing Will Result?

The three policy alternatives appear to be equally effective in reducing the pressures on the local housing market caused by a large influx of temporary construction workers from outside the area. If the first specific policy alternative requiring an adjustment in project schedules is selected, the constructed time of a coal gasification plant, for example, would be extended from 5 to 8 years. By extending the schedule to prevent any labor requirements exceeding 2,000 person-years annually, construction peaks would be spead over 2 or more years (see Figure 8-1-D). Thus, peak employment would be reduced by approximately one-third over the eight-year construction phase and would lessen the impact on housing demand by a similar amount.

The specific alternative calling for commuting to be encouraged would reduce the peak demand for temporary housing in the local community in direct proportion to the number of workers encouraged to commute from larger population centers. If the siting alternative is chosen, requirements could be established to keep labor-intensive facilities out of isolated, sparsely populated areas and placed in more densely populated communities where more housing might be available. Strictly speaking, this alternative does not reduce the peak demand for local housing in the impacted community, but it does reduce the strain of such demand by locating facilities so as to minimize the housing demand as a proportion of the total community housing demand.

(2) What Would It Cost?

Both labor and construction costs would likely increase if the construction of an energy facility were extended from 5 to 8 years. Interest costs on a $50 million coal mine built over 8 years instead of 5 years would amount to $2.5 million per year or $7.5 million for the three-year extension. Interest costs on a coal-fired power plant with a $1 billion costs would increase by $100 million if construction was lengthened from 8 to 10 years to reduce peak construction employment.[1] The increased costs associated with this policy alternative would also be reflected in increased energy costs paid by consumers and in inflationary increases in construction costs.

The second alternative, to increase long distance commuting, could be accomplished with minimal costs either to government or energy consumers. The costs of commuting would be assumed either by the individual worker if they continue to drive their own vehicles, or by the company if developers provide transportation for workers. Even if industries establish fleets of mass transit vehicles to transport up to 50 or 75 percent of the labor force from outlying population centers, the cost of this alternative would be lower than the expenditure required to meet the temporary peak demand housing in the development area. The risks of delayed energy production startup would also be minimal if this alternative were implemented, since new plant construction could proceed on schedule. The effects on worker productivity also appear to be positive because temporary construction employees and their families could live in the larger cities in the area where they would have access to a wider choice of housing, as well as a broader range of services and amenities.

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[1] This is calculated as one-half of the number of years added to construction times nominal project cost ($1 billion) times interest rate (10 percent).

If technological criteria are utilized to determine the location of energy facilities, small towns in the West can avoid many of the costs and risks associated with rapid growth in temporary construction population. The siting of labor-intensive facilities in areas of higher population density would completely eliminate the demand for temporary housing in isolated small towns. There would be no upward pressure on housing prices, and local developers and financial institutions would not face the risk of building for an energy boom that failed to materialize. It should be noted, however, that energy development also brings with it associated benefits to the local economy, and these would not be realized if facilities with high construction-phase labor requirements are prohibited.

(3) How Are the Costs, Risks, and Benefits Distributed?

The adjustment of project schedules for constructing facilities in impacted communities raises questions concerning differences in the impacts of western energy development on the West and on other regions of the country. For example, as noted above, the financial costs of energy facilities will increase when the construction period is extended; this will increase costs for both utilities and consumers, many of whom are outside the West. Consequently, policymakers have to consider regional trade-offs between the costs of energy to consumers and the costs of mitigating housing impacts in local areas of the West. If this policy alternative is implemented to reduce the peak demand for temporary housing, energy consumers in other parts of the country will likely pay higher prices for energy, and there will be delays in converting some utilities from gas and oil to coal. In this case, coal conversion required by the Energy Supply and Environmental Coordination Act of 1974[1] would conflict with the attempts of coal-producing states to reduce housing impacts.

The long distance commuting and siting alternative would have the effect of transferring impacts from a single community in the vicinity of energy development sites to an area where the population base is better able to absorb the peak demand for temporary housing. Thus, the costs associated with the construction of a facility are spread among more communities. The risk of adverse impacts is also reduced for any single community under these options, since the failure of energy development to materialize is less likely to leave a community with a surplus of temporary housing when the construction workers have been housed within various communities in an impact area.

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[1] Energy Supply and Environmental Coordination Act of 1974, Pub. L. 93-319, 88 Stat. 246, 15 U.S.C. 792.

(4) How Flexible Are the Alternatives?

The flexibility of adjustments in project schedules for a single facility is generally unrestricted. However, if two or more construction projects are proposed for the same area, coordination might be more difficult. The first firm to begin construction of an energy facility would be able to follow, to a large degree, its own preferred project schedule. Other firms that enter an energy resource area later would receive their siting permits contingent upon schedule adjustment (in most cases delay) to reduce local housing needs.

The commuter alternative is also very flexible, since no new mechanisms are required, and housing impacts can be spread among the available population centers. The voluntary nature of this option allows companies to experiment with various transportation modes to meet workers' needs. Plant shift schedules enabling workers to set up carpools and other transportation arrangements could be accommodated by this proposal.

The siting alternative is less flexible than those previously discussed. Siting choices for energy facilities are somewhat constrained by the labor force requirements of some technologies and the characteristics of particular sites. However, the basic distinction in terms of flexibility for this option is between the choice of sites and the actual construction of facilities. The choice of sites compares favorably with both project schedule adjustments and long distance commuting in terms of flexibility. Siting legislation already exists in several of the states in our eight-state study area and technological and locational factors are or can be incorporated as required site selection criteria. The problems of local communities can quite easily be taken into account. On the other hand, the actual construction of facilities is an irreversible decision that commits the company to a particular location. Thus, this option is less able to accommodate future shifts in population and housing impacts.

(5) Can these Alternatives Be Implemented?

Primary responsibility for implementing adjustments in project schedules rests with developers in conjunction with state and local government officials. Although the goal of reducing temporary housing demand is somewhat general, conditions specific to states and local areas would make federal involvement difficult.[1] Individual projects must be assessed to determine their impacts on communities, and the impacts of alternative schedules need to be compared. State industrial siting agencies generally already have the authority to acquire information on scheduling and to require some adjustments to schedules through conditional siting permits.[2] By tying compliance on schedules to a state-issued construction permit, the construction schedule becomes part of the definition of the project from its very beginning.

The initiative for implementing the long distance commuting option also rests with private industry, although state and local governments may offer some assistance in the form of tax incentives and informal cooperation. The primary constraint on the implementation of this alternative is likely to be the negative attitude of workers toward any form of organized transportation; most prefer to live in the vicinity of the development and drive their own vehicle. Industry might make long distance commuting appealing to workers by organizing company buses to and from major population centers. These could be staffed by attendants who would serve coffee, beer, and refreshments en route.

State governments would have responsibility for implementing the technological/locational siting option, which may require new legislation to carry out. The acceptability of these types of siting policies are considered in some detail in Chapter 12.

(6) Summary of Alternatives to Decrease the Number of Workers Living On-Site

Findings for the evaluation of each alternative for reducing the peak demand for temporary housing are presented in Table 8-8. Each of the alternatives analyzed--adjusting project schedules, encouraging long distance commuting, and applying technological and locational criteria in siting--would reduce the demand for temporary housing in local communities during the construction phase.

The evaluation discussion illustrates that the five criteria can rarely, if ever, be met simultaneously. Therefore, when policymakers select a mix of policies and implementation strategies

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[1] Without national energy facility siting legislation, federal control over project schedules would be unlikely. See Chapter 12 "Energy Facility Siting," on this point.

[2] Industrial Development Information and Siting Act of 1975, Wyoming Statutes §§ 35-502.75 et seq. (Cumulative Supplement 1975). See the discussion on state siting laws in Section 8.2.2 and in Chapter 12, "Energy Facility Siting."

TABLE 8-8: EVALUATION OF ALTERNATIVES TO DECREASE THE NUMBER OF WORKERS LIVING ON-SITE

CRITERIA	MEASURES	FINDINGS
Effectiveness Are the objectives accomplished?	Reduction in housing demand	Adjusting project schedules could reduce the peak work force and housing demand by one-third during construction. Long-distance commuting could relocate most (up to 80 percent) workers from on-site communities to large cities. Some facility siting policies could keep very labor-intensive technologies away from some areas, reducing peak demand by about one-half compared to other technologies.
	Increase in housing supply	All three alternatives would not actually increase supply, but would reduce the strain on existing supply in local communities.
	Improvement in housing quality	Housing quality would not be improved, but it also would not be decreased.
Efficiency What are the costs, risks, and benefits?	Economic cost	Extending project schedules could increase interest costs alone by 10 percent of project cost per year, and construction would be subject to additional inflation costs. Long-distance commuting would be less costly, and would depend on the number of workers transported. Siting near larger towns would increase housing costs in those towns and energy development might be more expensive than at best resource sited.
	Risk of loss	There would be little risk associated with these alternatives, with the important exception of project financing. Investors might be less attracted to projects that are high in cost because of these alternatives.
	Availability of housing	Under all three alternatives, local housing availability would be improved by lower demand.
	Change in worker productivity	Productivity should increase (and project costs decrease) if the housing situation is improved in local areas. This is most likely for project schedule adjustment and long-distance commuting.

TABLE 8-8: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity Who receives the costs, risks, and benefits?	Costs	Energy developers and, ultimately, consumers would pay for increases in project costs. Residents of large cities from which commuting takes place or near where facilities are sited would have additional housing demand and probably higher prices.
	Benefits	Residents of small towns near energy developments would have more stable housing markets and fewer mobile homes.
	Risks	There is some risk that higher-cost projects will be less feasible financially.
Flexibility Is the alternative flexible enough to be applicable in a variety of circumstances?	Adaptability	Project schedule adjustments can be tailored to specific project and local housing market conditions, as can commuting options. Siting policies would be less adaptable, eliminating all projects of a certain type from designated areas.
	Adjustability	If housing demands are different than expected, project schedules and commuting probably could be changed. As a govermental policy, siting decisions would be less reversible, particularly for individual projects.
Implementability How difficult would it be to implement the alternative?	Changes required	Industry could voluntarily adjust schedules; states with conditional permits in siting laws have the power to require this. Commuting could be voluntarily initiated, and federal or state financial incentives could be added. Siting laws would need to specify technology and site combinations that are excluded.
	Parties involved	Industry would resist costly alternatives unless consumers would be charged. Workers might not want to commute long distances daily or weekly so labor shortages could result.

which reduce some of the peak demand for temporary construction housing, they will also have to balance considerations of effectiveness, efficiency, equity, flexibility, and implementability contained in the various alternatives. For example, if the major objective is to achieve the maximum reduction in housing demand, technological and locational factors should be a requirement for siting facilities, the requirement being to locate labor-intensive plants near more densely-populated areas. This alternative would also minimize the costs and risks of housing impacts for small, isolated towns and spread housing demand over a broader area. Siting criteria would be fairly easy to implement since many states already have siting laws, but once facilities have been constructed, the siting decision becomes irreversible. The adjustment of project schedules would increase both energy and construction costs, but would reduce peak temporary housing demand by about a third.

C. Evaluation of Alternatives for Increasing Housing Construction and Financing

The goal of this category of policy alternatives is to increase the level of private market homebuilding activity in energy impacted communities through industry or industry/government actions. The specific alternatives included here assume that local housing markets require commitments from the energy industry or guarantees from government to increase housing availability.

This section evaluates and compares three specific policy alternatives for preserving and strengthening the private housing market role in the West:

- Make state energy facility siting permits conditional on industry agreement to provide housing for the workers it expects to employ;
- Provide incentives and inducements to stimulate energy industry investment in housing or guarantee of housing financing;
- Provide federal or state government guarantees of home loans in the secondary mortgage market.

These alternatives can be implemented by employing a variety of strategies. The following three strategies are somewhat representative of the range of actions which might be adopted to implement various policy alternatives:

- Require developers to provide housing as a precondition for obtaining siting permits;
- Provide tax incentives to spur housing investments;

- Provide federal and state loan guarantees in the secondary mortgage market and direct grants and loans to stimulate construction.

None of these alternatives will satisfy all five criteria simultaneously. Thus, policymakers will be required to choose alternatives which make trade-offs.

(1) How Much New Housing Financing and Construction Will Result?

It is impossible to generalize about the amount of new housing that would be made available by these alternatives. Although many states have siting laws, few have had any experience with conditional siting based on impact mitigation. Perhaps the best known example of the use of siting legislation in the West to require housing construction involves Basin Electric Power Cooperative in Wheatland, Wyoming. As noted earlier, the utility agreed to provide 1,900 homes, together with other mitigation assistance, in return for permission to site a power plant near the community.[1] Generally, if policymakers choose to implement siting legislation requiring industry to agree to provide housing for its employees before receiving a permit, they can ensure that the housing will at least be adequate to mitigate the impacts of the proposed facility.

The amount of new housing provided by the industry guarantees alternatives will also vary on a case-by-case basis. Industries in the West have been increasingly willing to provide guarantees to private developers for a specified number of homes. Housing built with developer backing has included both single- and multifamily units and has involved assistance ranging from permanent mobile home spaces to modernization of older homes. The quantity of housing provided is likely to be adequate to meet the needs of workers employed by the developer but typically will not be available to contract or service workers and their families.

Based on the assistance currently provided by state and federal housing assistance programs,[2] it is estimated that federal and state support for the secondary mortgage market could potentially be doubled to provide loan guarantees for housing in energy-impacted communities. Grants and loans direct to builders and developers could reduce the risk and difficulty of obtaining financing for those firms and increase local housing supply.

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[1] See Valeu, R.L. "Financial and Fiscal Aspects of Monitoring and Mitigation." Paper presented at the Symposium on State-of-the-Art Survey of Socioeconomic Impacts Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977.

[2] U.S., Department of Energy, Energy Impact Assistance Steering Group. Report to the President on Energy Impact Assistance, Draft Report. Washington, D.C.: U.S., Department of Energy, 1977.

(2) What Will It Cost?

The cost of housing measures can escalate quickly depending on the policy alternative chosen. For example, costs can range from about $5,000 per unit for site development, to more than $30,000 per unit for house construction. Lot preparation and development for 1,900 homes in Wheatland, Wyoming, cost about $10 million, or over $5,200 per unit.[1] Thus, even 100 lots without homes can cost as much as $500,000 to develop. Firms also face the risk of holding unsold homes if energy development plans are delayed or cancelled. However, if development does occur, most if not all housing in western towns can be sold so long as financing is available.

The costs of state and federal assistance and guarantee programs are exemplified by Colorado's sale of $50 million in housing financing bonds and $34 million of bonds to finance construction loans.[2]

(3) How Will the Costs, Risks, and Benefits of these Alternatives Be Distributed?

A question of equity which arises in siting legislation concerns deciding to which facilities the law should apply. The political strength of mining companies in some states in our study area may make it difficult for state legislatures to include this requirement. While large energy conversion facilities are generally believed to be the cause of large-scale impacts, housing facilities provided by industry are typically available primarily or exclusively for company employees. No provisions are made for the needs of service workers who move to the development area to meet the needs of construction workers. The risks and interest charges on home construction financing provided by private firms are generally carried by the energy developer in the short term and later passed on to consumers.

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[1] Valeu, R.L. "Financial and Fiscal Aspects of Monitoring and Mitigation." Paper presented at the Symposium on State-of-the-Art Survey of Socioeconomic Impacts Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977.

[2] Carlisle, N. "Boomtown Housing: The Problems and Possible Solutions," in Bronder, L., N. Carlisle, and M. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977, p. 497.

When state and federal programs are utilized to provide increases in housing financing and construction, the taxpayer bears the risks and costs. In the case of state programs financed by severance taxes, utilities pay the increased costs when they buy the fuel and pass it on to consumers by increasing their rate base.

(4) How Flexible Are the Alternatives?

Conditional siting permits, industry investment in housing, and state and federal housing assistance programs are generally quite flexible in dealing with the housing needs specific to a given locality and within states as a whole. Siting permits conditioned on industry provision of housing are especially able to meet the specific type and degree of impacts of energy development in particular communities.

(5) Can the Alternatives Be Adopted?

Industry acceptance of housing construction requirements depends to some extent on the advantages of the siting permit procedure. If the state permit substitutes for many or all current state permits (one-stop siting), then the time and cost savings in permit applications can be used to provide housing or other community facilities. (If federal permits also could be consolidated, the savings would be even greater.) On the other hand, an additional permit requirement would find little industry support, even without mitigation requirements.

(6) Summary of Alternatives to Increase the Quantity of Housing Finance and Construction

Table 8-9 identifies the conclusions reached on each evaluative criterion for alternatives that increase the quantity of housing finance and construction. As indicated in the table, there is no alternative that meets all of the criteria simultaneously, so policymakers will have to balance considerations of effectiveness, efficiency, equity, flexibility, and implementability in choosing a combination of policies and implementation strategies to increase the quantity and availability of housing financing and construction.

8.4 SUMMARY AND COMPARISON OF HOUSING ALTERNATIVES

Population growth associated with energy resource development in the West can seriously affect both the quantity and the quality of housing available to energy and service workers and their families in nearby communities. A variety of alternatives to avoid or mitigate these impacts has been presented in this chapter. Policymakers choosing any of these alternatives will find it necessary to make trade-offs among costs, risks, and benefits. The

TABLE 8-9: EVALUATION OF ALTERNATIVES TO INCREASE FINANCE AND CONSTRUCTION

CRITERIA	MEASURES	FINDINGS
Effectiveness Are the objectives accomplished?	Reduction in housing demand	These alternatives do not address reducing housing demand, but they would reduce the stress placed on housing supply.
	Increase in housing supply	The provision of guarantees by energy developers or the public sector would stimulate housing construction in all but towns without a local construction industry. Policies that involve construction rather than increasing financing might work better in towns with conservative lenders.
	Improvement in housing quality	Some programs could be targeted at high-quality mobile home parks or similar developments. Generally, these alternatives do not address quality.
Efficiency What are the costs, risks, and benefits?	Economic cost	Full construction would require at least $30,000 per housing unit or $5,000 for lot development alone. Guarantees would not cost anything if homes are sold; partial guarantees are also possible.
	Risk of loss	Industry costs would need to be passed on to consumers. Ultimately, consumers and taxpayers bear the risk of having to cover guarantee costs. The risk on guarantee programs would be very low if housing demand is met closely.
	Availability of housing	Housing supply would improve by the number of new homes built, possibly easing the local money supply and making additional financing available for further construction.
	Change in worker productivity	Existing evidence supports the notion that projects whose workers are satisfied with their housing have higher productivity.
Equity Who receives the costs, risks, and benefits?	Costs	Energy firms bear interest charges on construction and pass them on to consumers. Federal and state programs pass costs on to taxpayers. Government programs spread the cost somewhat more widely than industry programs.

TABLE 8-9: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity (Continued)	Benefits	Residents in western energy towns will have an improved housing market, and western towns will be less identified as "trailer towns." Builders and developers would have more stable demand with all the alternatives.
	Risks	Firms (and their consumers) bear the risk of guaranteed homes not being sold if too many are constructed; taxpayers would pay for some in federal or state programs.
Flexibility Is the alternative flexible enough to be applicable in a variety of circumstances?	Adaptability	These alternatives would not be needed near large urban areas. Federal programs would be less adaptable to local conditions than state siting and assistance programs. Siting permit conditions would be most adaptable to individual energy projects.
	Adjustability	None of the federal programs would be easily changed to meet changing needs once a project is underway, but state siting permit conditions could be adjusted most easily.
Implementability How difficult would it be to implement the alternative?	Changes required	Industry is already making many efforts about housing workers. Other firms would need to be involved and other housing demands (from service workers) included. Some state siting laws work as this chapter suggests; others would need legislation to follow. Federal housing programs would need legislation and funding to be put into effect.
	Parties involved	Industry would resist measures beyond what they would voluntarily do. Builders and housing developers would have a more stable market. Taxpayers outside the West may resist funding housing programs for the West only; eastern mining communities could be covered similarly. Subsidizing high-income workers would also not receive favorable reaction among taxpayers.

trade-offs have been discussed in terms of five criteria for evaluating various policy alternatives. The conclusions of this analysis for two representative categories of alternatives are presented in Table 8-10.

The categories of alternatives that were subjected to additional evaluation in this chapter respond to two different goals of housing policy in the western United States.[1] The first general category of alternatives aims at avoiding the housing impacts of energy development in western communities. In constast, the second category of alternatives acknowledges that energy development is now occurring in many western communities and is inevitable in others. Thus, this second set of alternatives is designed to increase the amount of housing financing and construction that is available through the private market.

Some of the peak demand for temporary housing in energy development communities could be avoided if policymakers locate fewer workers in small western communities. All such options would increase the cost of energy development in order to reduce the housing impacts. Policies to increase the supply of housing, by providing finance and construction funds, are less costly and can easily be used in communities where impacts are already occurring. The supply alternatives analyzed here also are more flexible and can be tailored for the housing situation in particular states and towns.

The role of energy developers in reducing boomtown-type impacts will need to be increased, as discussed earlier in this chapter. Particularly in housing, the private sector has ample opportunity to alleviate impacts and, indeed, to make a sound investment. Federal programs are much more difficult to aim at the specific needs of individual communities, although the cost can be spread broadly to all taxpayers. Overall, no single policy alternative can be the best; rather, several different options will have to be implemented together to improve the housing situation in western energy towns.

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[1] Policy alternatives to meet the goal of improving housing quality were described, but not evaluated, in this chapter.

TABLE 8-10: A COMPARISON OF THE DEMAND REDUCTION AND HOUSING SUPPLY ALTERNATIVES

CRITERIA	MEASURES	FINDINGS
Effectiveness Are the objectives accomplished?	Reduction in housing demand	Demand reduction alternatives would do more to alleviate housing demand; of those considered, only adjustment of project schedules allows construction to take place with workers living on-site in western locations.
	Increase in housing supply	Housing construction and guarantee programs can increase supply locally. Siting permit requirements would work in states with such laws.
	Improvement in housing quality	Generally these programs do not address quality, although finance and construction policies could improve mobile home parks.
Efficiency What are the costs, risks, and benefits?	Economic cost	The cost of guarantees can be low or nothing, but would be at least $30,000 per home if left unsold. All demand reduction alternatives add substantially to project costs, probably by at least 10 percent.
	Risk of loss	The risk in demand reduction alternatives is through higher project costs which might deter investment. Proven technologies would not be greatly affected. Risks on housing guarantee programs would be low unless demands were badly overestimated.
	Availability of housing	Demand reduction alternatives would reduce the strain on existing housing supply. Finance and construction alternatives would add directly to supply or to financing, easing shortages.
	Change in worker productivity	Worker productivity would be enhanced through improved local living conditions in all cases except long-distance commuting and siting alternatives. Depending on where workers would be living (a new site or larger city), productivity might or might not be affected.
Equity Who receives the costs, risks, and benefits?	Costs	Consumers and taxpayers would ultimately bear most costs. If larger cities are used for worker locations, as in the siting and commuting alternatives, house prices could increase in those places.
	Risks	Taxpayers and firms bear risks that guarantee programs will be costly if houses are not sold. High-cost projects might be less financially feasible due to added costs for demand reduction measures.

TABLE 8-10: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity (Continued)	Benefits	Residents in western towns would have enhanced quality-of-life because of an improved housing market. Local builders and developers would have more stable business.
Flexibility Is the alternative flexible enough to be applicable in a variety of circumstances?	Adaptability	Siting permits can fit measures taken to local conditions, whether through schedule adjustment or guarantee/construction programs. Federal policies would be less flexible, as would siting near larger cities.
	Adjustability	Project schedule and commuting alternatives could be changed easily over time. Housing supply alternatives are not flexible, except through state siting provisions.
Implementability How difficult would it be to implement the alternative?	Changes required	Alternatives requiring federal legislation would be more difficult to get national support for. Industry actions are largely ongoing, but not all measures are taken by all firms.
	Parties involved	Industry might resist requirements of housing construction, schedule adjustment, and siting elsewhere. Western workers may not want to commute long distances. Taxpayers would not pay very much individually, but would not like subsidizing housing for high-income workers.

CHAPTER 9

GROWTH MANAGEMENT

EXECUTIVE SUMMARY

Energy resource development in the West can seriously affect quality-of-life, particularly in small, isolated communities for energy workers and their families. In addition to being affected by the housing problems discussed in the previous chapter, public services and facilities in most energy-impacted communities will almost certainly be inadequate to meet the needs of the greatly increased population which energy development will bring. The problems which people and communities can expect to face are compounded by fluctuations in population due to changes in the size of the work force, a lack of adequate funds, especially for capital expenditures, a general lack of a professional management and planning capability, and, often, the inadequacy or absence of impact assistance programs.

Impacts

Growth management impacts will depend on characteristics of the energy development technology and its location. The most important technological characteristics influencing growth management problems are labor requirements and scheduling. Critical locational factors include size and location of the impacted community and distribution of revenues among counties, school districts, and municipalities.

Our analysis of growth management impacts resulting from western energy resource development suggest that:

- Communities close to coal gasification and liquefaction facilities will face the largest immediate demand for services and facilities, since peak construction population increases for these facilities are considerably larger than any other conversion facility.
- Communities near coal gasification plants and electric power plants also will experience serious boom and bust cycles, since these facilities have the largest ratio of construction to operation employment. This means that

these communities will not only have a very difficult time in meeting immediate growth needs, but could also have large excesses of services or facilities after the construction stage.

- Smaller communities, generally those under 5,000, close to energy facilities will have the most difficult time managing growth, since population increases will represent large percentage changes and few professional planning capabilities exist in these towns (Table 9ES-1).
- Isolated towns impacted by energy development will be harder hit than areas where several towns will share population increases.

TABLE 9ES-1: POPULATION GROWTH IN SELECTED ENERGY-IMPACTED WESTERN COMMUNITIES, 1970-1977

TOWN	POPULATION		AVERAGE ANNUAL INCREASE
	1970	1977	PERCENT
Carbondale, CO	726	1,600	17
Grand Valley, CO	270	500	12
Craig, CO	4,205	6,657	8
Rifle, CO	2,150	3,500	9
Hardin, MT	2,733	3,637	5
Washburn, ND	805	1,400	10
Huntington, UT	857	1,700	14
Gillette, WY	7,192	10,200	6
Douglas, WY	2,677	7,200	25
Moorcroft, WY	981	2,000	15
Wheatland, WY	2,500	4,500	11
Rock Springs, WY	10,500	23,250	17

The Policy Context

Several elements of the existing policy system influence the seriousness of these impacts on energy-impacted areas of the West. One of the most important of these is the relationship among municipal governments, counties, and school districts. Benefits of increased revenues from energy facilities, largely from property taxes, go to counties and school districts since the facilities are usually located outside municipal boundaries. However, municipalities face the most serious growth management impacts because most workers and their families live in or very close to towns. Moreover, in the western states, counties typically have been reluctant to share responsibility for debt related to increased town populations.

State laws and financial structures are also critical to local growth management. States with severance taxes on coal and other energy resources can redistribute portions of the tax to impacted areas. In the eight-state study area Montana, North Dakota, and Colorado have relatively high coal severance taxes. Utah has no severance tax, and in the other states the tax rate is relatively low. A small portion of this revenue is returned to impacted areas for water and sewer facilities, schools, and roads, but most goes instead into trust funds or capital facilities statewide.

In contrast to helping impacted areas by redistributing severance taxes, all western states limit the amount of bonded debt which towns, counties, and school districts may assume. This further restricts the ability of these local governments to finance and construct public facilities prior to population impact.

Some federal programs intended to deal with local impacts are based on the location of federal lands and-or resources. This has the effect of assisting the counties and school districts in which these are located, but not the towns receiving the population impacts. No federal programs currently exist specifically to deal with population impacts associated with energy development.

Water and sewage treatment facilities are the largest expenditure items for municipal facilities. Sewage treatment is almost exclusively a municipal expenditure, since few areas in the West outside of towns have public sewage service. In addition to needs for expanding water supply and sewage treatment facilities as a consequence of population growth, the Clean Water Act of 1977 requires upgrading of existing facilities to include secondary treatment of sewage by 1983. Over one-half of the towns affected by energy development in six western states either lack a water or sewer system or have reached capacity in their existing systems. Upgrading treatment works to the new standards adds to local governments' financial burdens.

Some of the financial difficulty could be ameliorated by the Wastewater Construction Grants Program, administered by the Environmental Protection Agency (EPA). However, the program has run into administrative delays in the distribution of funds, and is focused more at large cities than at small towns. Large cities are favored by procedures that allow metropolitan communities to apply directly to EPA, whereas nonmetropolitan towns are required to go through a state agency for funds (see box "Out of Step").

Together with the impacts of rapid, large, and unstable population changes, these characteristics of the policy system contribute to three particular issues likely to increase with energy resource development:

- Revenue and service imbalances will persist among local government units. Counties and school districts can anticipate rapid and large tax revenue increases from energy facilities, while towns which incur the major population growth impacts receive little additional revenue.

- Public and private sector cooperation in planning for impacts is inadequate. The tendency is to deal only with the employees of an individual company, rather than with overall energy impacts affecting long-time residents and service workers as well. Planning and growth management are made more difficult by a shortage of information about the timing, magnitude, and location of development.

- State and local governments will increasingly compete for direct access to federal funds. Most federal guidelines require small towns to apply through state agencies, which many local officials believe are unresponsive to local needs.

OUT OF STEP

Mayor Mike Enzi of Gillette, Wyoming has a string of stories to tell about being turned down for federal money. EPA rejected a request for sewage treatment facilities because Gillette already had a treatment plant and must wait until 27 other towns in Wyoming get their first ones. Most other economic assistance is intended for urban areas and high-unemployment areas, not for areas with growth and low unemployment such as Gillette.

--Enzi, M.B. "Energy Boom: Wyoming's Coal Veins Just Bring Troubles."
Los Angeles Times, May 15, 1977, p. V-3.

Alternative Policies

In dealing with growth management problems and issues, policymakers can pursue two complementary objectives: they can provide funds to enable energy-impacted towns to accommodate increase population adequately, and they can assure these communities receive planning assistance and accurate and timely information about energy development. Two general alternatives can be used to achieve the first objective:

TABLE 9ES-2: ALTERNATIVE POLICIES FOR GROWTH MANAGEMENT

POLICY OBJECTIVE	CATEGORY OF ALTERNATIVE	SPECIFIC ALTERNATIVE
Provide adequate financing for western towns to accommodate energy-related population growth	Change state and local tax structure	Municipal annexation of county land Prepayment of property and sales taxes State collection and distribution of property taxes on energy facilities Redistribution of state severance tax funds to impacted areas Tax credits for private sector impact assistance
	Energy impact assistance	Special programs for water and sewer facilities in nonmetropolitan rapid-growth areas Distribution of federal land and mineral payments directly to impacted towns Federal and regional impact assistance for municipalities
Assure that energy-impacted communities receive adequate and timely information	Energy impact planning	Federal growth management planning assistance State siting legislation requiring impact information

- Changes in local and state tax structures;
- Increased impact assistance.

As shown in Table 9ES-2, local and state tax structure changes include municipal annexation of county land so that energy facilities could be included in a town's tax base. Prepayment of property taxes to local governments could alleviate the lead-time problem during facility construction, and the provision of tax incentives to encourage private sector impact assistance would stimulate energy company initiatives to provide assistance. State severance taxes on mineral mining are an important source of state revenue in the West, and property taxes on energy facilities could potentially provide additional revenue for impact assistance. However, neither tax can be helpful to local governments unless the distribution system is made more efficient and flexible.

Energy impact assistance programs could alter two existing federal programs to make them more applicable to western towns. For example, water and sewage treatment grant programs could be altered to include specific criteria for energy development impacts or, more broadly, for rapid growth situations nationwide. Federal programs involving royalties and payments based on land and mineral location could be altered to require states to allocate funds to towns rather than to county governments. Additional funding for impacted communities could be channeled through the Economic Development Administration or Title V regional commissions.

The policy alternatives discussed above generally attempt to redistribute the financial impact of energy-related growth management problems. Alternatives for meeting the second objective focus more on energy development planning as a means of reducing, or at least anticipating, impacts. A comprehensive information, planning, and assistance program could avoid many of the current impacts on local communities in future energy development activity. The Hart/Randolph impact assistance bill currently under consideration in Congress is one such measure. At the state level, facility siting legislation with impact information requirements can provide the knowledge necessary for local planners to deal with impacts. Conditions can also be attached to siting permits to require energy developers to mitigate impacts directly.

Findings

Two categories of alternatives for providing adequate financial assistance to impacted communities have been evaluated: tax structure changes and increased impact assistance.

Both categories of alternatives have the potential to increase revenues and distribute them more directly to impacted communities. While methods for increasing energy impact assistance appear to be more effective in supplying the necessary amount of financial assistance, changes in the tax structure are the most direct and effective means of dealing with the "front-end" problems of impacted communities.

The economic costs of increasing impact assistance will exceed those of changing the tax structure since the latter primarily reallocates existing financial resources. Since our analysis shows the total tax benefits to most local areas to be more than adequate, redistribution policies appear to be the most effective and efficient policies for dealing with growth management problems.

The distribution of costs, risks, and benefits is more equitable if the direct beneficiaries of energy development also bear a share of the costs. This is most likely to be a result of alternatives to change the tax structure. Broader considerations of equity involve the values, preferences, and perspectives of individual policymakers. For example, Montana officials defend their states' 30 percent severance tax as a reasonable public policy, but eastern utilities argue that the rate is excessively high.

In terms of flexibility, increases in federal and regional impact assistance programs appear to be more adaptable to the variety of impact needs of communities in different western states. Both categories of alternatives are capable of being easily adjusted to specific situations and used in combination with other alternatives.

Changes in existing federal impact assistance programs would be easier to bring about since several of these specific alternatives involve only incremental changes in existing federal policy. For this category of alternatives, the particular implementation strategies chosen will, in large part, determine the acceptability of a specific alternative. Several of the specific alternatives for changing jurisdictional control over revenue sources also could potentially lead to political problems, since state and local governments view the loss of control as a reduction in their authority and their flexibility to address energy impacts.

Conclusion

Although this summary and comparison of two categories of growth management alternatives identifies for policymakers the range of problems and issues involved in alleviating the socioeconomic impacts of energy resource development in the West, it is also apparent that this analysis cannot resolve all of the questions that are likely to be raised in making choices to address these problems and issues. This is true in part because important information is lacking. For some specific alternatives, there is too little current experience to judge the effect a policy will have on the alleviation of energy impacts. This lack of information affects what alternatives are evaluated as well as how they are evaluated.

Growth management problems and issues are somewhat more difficult to deal with than other issue areas in western energy development. They are immediate and costly problems which could affect hundreds of local governments in the West, and they make financial demands on a federal system that has little funding for small towns and rural areas. Moreover, antagonisms between federal, state, and local governments over the distribution of tax receipts and other revenues engender conflicts over most aspects of growth management. Until the institutional mechanisms for state and local planning are improved, energy impacts will continue to be dealt with on a piecemeal and uneven basis in various states and communities.

CHAPTER 9

GROWTH MANAGEMENT

9.1 INTRODUCTION

Energy resource development in the West can seriously affect quality of life, particularly in small, isolated communities and for energy workers and their families. In addition to being affected by the housing problems discussed in the previous chapter, public services and facilities in most energy-impacted communities will almost certainly be inadequate to meet the needs of the greatly increased population which energy development will bring. The problems which people and communities can expect to face are compounded by fluctuations in population due to changes in the size of the work force, a lack of adequate funds especially for capital expenditures, a general lack of a professional management and planning capability, and a characteristic absence of impact assistance programs.

This chapter focuses on these growth management problems and issues. Following a brief summary of the impacts and policy context described in detail in the previous chapter, specific local service problems and issues are identified and discussed. This is followed by an analysis of alternative policies and implementation strategies for dealing with these problems and issues.

9.1.1 The Population Growth Impacts of Energy Resource Development

Growth management impacts can vary significantly depending on the characteristics of the energy development technology and the location at which it is constructed and operated. The technological factors or characteristics which can significantly affect growth management impacts are labor requirements (both the size and stability of the work force) and scheduling, both for the individual facility and in relation to other facilities. Locational factors or characteristics which can significantly affect growth management impacts are size and location of the impacted community and the distribution of revenues among various jurisdictions, for example among counties, school districts, and municipalities.[1]

Since many energy facilities require far more personnel during construction than during operation, local communities are often hard-pressed to provide the full range of local services and facilities to workers, their families, and service and support personnel during construction. However, some of these impacts can be mitigated by extending the construction phase of a single facility or delaying the construction of other facilities in the same area, but construction costs will be increased and impacts will not necessarily be reduced in direct proportion to the decrease in population which the scheduling change produces.

A. Community Size and Location

The most important factor influencing population impacts is the size of a community before energy development begins. Larger cities (over about 10,000 population) generally serve as major market centers for a wide area and, therefore, have more diversity and capacity for growth in the public and private sectors.

A professional planning staff capable of in-house planning is also more likely to be available in large towns. Services and facilities are more likely to be available and easier to expand than in smaller communities. In fact, most large towns and small cities already have plans for expanding the services and facilities which they provide.

In addition to size, the number of communities in the vicinity of an energy development will help to determine the magnitude of impacts that any one community will experience. An isolated town where nearly all workers and their families live will be impacted much more than will any one town in an area where the new population is distributed more widely among several towns. For example, Gillette, a small isolated city in northeastern Wyoming, has absorbed virtually all of the impacts of large-scale coal development in Campbell County. On the other hand, development impacts in western Colorado have been distributed among Rifle, Grand Valley, Meeker, and Rangely.

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[1] See White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

B. Jurisdictional Distribution of Revenues

In much of the eight-state study area, the benefit of increased revenues which comes with energy development accrues to a jurisdiction other than the one that experiences the most serious growth management impacts. Property tax revenues usually go to counties and school districts, not to the municipalities where most of the workers and their families live. Increased sales tax revenues most often go to the small cities which are the regional trade centers rather than to the energy-impacted community. In nearly all energy-impacted communities, therefore, government has been unable to keep up with demands for services, and planning for future rapid growth has been even more difficult.

9.1.2 Effects on the Quality of Life

Energy development can seriously affect the everyday lives of residents of impacted communities. Inadequacies in these services translate directly into residents' perceptions of adverse effect on the quality of life.

Public service shortages are common in small towns everywhere, including those in the West, and the actual effect of energy development is often difficult to determine. Most surveys conducted in the region list local services and ask for level of satisfaction. For example, residents in preimpacted communities and in those "currently affected" by energy development do not differ substantially on satisfaction with some community attributes. That is, in two communities not yet affected by development, residents were very dissatisfied with local streets and roads and housing availability and quality. These responses are similar to those for five communities currently affected by development.[1]

A broader research technique that does not restrict the range of responses can identify social impacts, as opposed to reactions to levels of services. However, surveys are still uncommon in energy-impacted areas of the West; journalistic descriptions tend to be much more common.[1]

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[1] See Mountain West Research. Construction Worker Profile, Final Report and Community Reports. Washington, D.C.: Old West Regional Commission, 1976.

Although many services are seen as being needed in small towns, less tangible problems such as social stress are more difficult to document. Long-time residents, in particular, can be affected if they do not want growth and the related changes. As a result, an animosity between newcomers (who personify growth) and long-time residents can easily develop.[2] However, there is some evidence that this ill will is more imagined than real.[3] But the stereotypic view that newcomers are kept out of long-time residents' society, a social distance that particularly affects women and school children, still persists.[4]

The most comprehensive survey of residents' satisfaction with local services that has been conducted was done as part of the Construction Worker Profile.[1] The composite results from nine communities reveal that long-time residents tend to be more satisfied with local services than are newcomers and that college-educated and high-income households are more dissatisfied with local services.[2] Long-time residents seem to see a need for improvement in such services as streets, water supply, and housing; newcomers also tend to prefer an improved range of shopping, entertainment, and other private businesses.[3] However, both groups agree that improvement in impacted communities is needed.

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[1] Structured surveys on this topic are given many titles, such as needs assessments and citizen policy surveys. Examples are Gilmore, J.S., and M.K. Duff. Boom Town Growth Management. Boulder, Colo.: Westview Press, 1975, pp. 89-177; Pernula, Dale. City Gillette/Campbell County: 1977 Citizen Policy Survey. Gillette, Wyo.: Gillette/Campbell County Department of Planning and Development, 1977; Uhlmann, J.M., R. Kimble, and D. Throgmorton, A Study of Two Wyoming Communities Undergoing the Initial Effects of Energy Resource Development in the Powder River Basin: Buffalo and Douglas, Wyoming--1975. Cheyenne, Wyo.: University of Wyoming, Department of Anthropology, 1976.

[2] Fradkin, P.L. "Craig, Colorado: Population Unknown, Elevation 6,185." Audubon, Vol. 79 (July 1977), pp. 118-27; University of Montana, Institute for Social Science Research. A Comparative Case Study of the Impact of Coal Development on the Way of Life of People in the Coal Areas of Eastern Montana and Northeastern Wyoming. Missoula, Mont.: University of Montana, Institute for Social Science Research, 1974.

[3] Newcomers surveyed in two Wyoming towns believed old-timers saw them much more negatively than the old-timers actually did. See Uhlmann, Kimble, and Throgmorton. Two Wyoming Communities.

[4] Kneese, A.V. "Mitigating the Undesirable Aspects of Boom Town Development," pp. 74-76 in Federation of Rocky Mountain States. Energy Development in the Rocky Mountain Region: Goals and Concerns. Denver, Colo.: Federation of Rocky Mountain States, 1975; Fradkin. "Craig, Colo."

9.1.3 Organization of the Paper

As mentioned earlier, growth management is the major concern addressed in this chapter. Section 9.2 discusses the background of problems and issues surrounding local services and facilities, and Section 9.3 presents and evaluates policy alternatives for this category of problems and issues. Alternatives are summarized and compared in Section 9.4.

9.2 THE CONTEXT OF LOCAL GROWTH MANAGEMENT ISSUES IN THE WEST

The rapid population growth associated with energy development greatly affects the ability of nearby local governments to respond to increased demands for services generated by that growth.[4] Municipal services and facilities quickly become inadequate for long-time residents as well as for people who move into the area because of energy development. Many public services, such as water supply, sewage treatment, and medical care, can accommodate increased demand only if new facilities are constructed. The construction of these facilities takes time as well as money and results in a lag between the time when service needs arise and when revenues are available. This "lead time" problem is particularly serious in the case of energy-related construction near small towns, where most western energy development will take place.[1]

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[1] Mountain West Research. Construction Worker Profile, Final Report and Community Reports. Washington, D.C.: Old West Regional Commission, 1976. This study included a Project Survey, concerning the location, origin, and family characteristics of 3,168 energy construction workers on 14 projects; a household survey of 1,432 households in nine western communities (five currently affected by construction, two postimpact towns, and two preimpact towns); and a community survey utilizing participant observation in three communities.

[2] Mountain West Research. Construction Worker Profile, pp. 57-58.

[3] Mountain West Research. Construction Worker Profile, Community Reports. This was the same trend found in the study by Uhlmann, J.M., R. Kimble, and D. Throgmorton. A Study of Two Wyoming Communities Undergoing the Initial Effects of Energy Resource Development in the Powder River Basin: Buffalo and Douglas, Wyoming--1975. Cheyenne, Wyo.: University of Wyoming, Department of Anthropology, 1976.

[4] See Section 8.1 for documentation of this growth.

In addition to the "lead time" problem, disparities also arise among local and state jurisdictions in the distribution of costs and revenues associated with energy development. New property taxes and other revenues from an energy project often go to the county, school district, and/or the state, while the major need for services and facilities occurs in the communities where the workers and their families actually live.[2] These needs can arise in a county or state other than that where the energy development takes place. For example, the Decker mine in southeastern Montana, the nation's largest producing coal mine, has a work force of about 300, but nearly all the workers and their families live just south of Decker, in and around Sheridan, Wyoming. Thus, Montana receives a severance tax on the coal produced, whereas Sheridan and the state of Wyoming receive no coal-related revenue from the mining operation. There are numerous other examples of similar jurisdictional conflicts between towns and counties, and between counties, throughout the West.

The public services and facilities needed in a community vary somewhat according to population. For example, court, detention facilities, and juvenile treatment facilities tend to be found in all larger towns (10,000 population and larger), but may not exist in smaller towns.[3] Other services and facilities are needed in all towns. One recent study of boomtown financing listed the following needs in order of priority:[1] (1) fire protection; (2) law enforcement; (3) water; (4) sewage treatment; (5) solid waste collection and disposal; (6) hospital and medical facilities; (7) detention facilities; (8) juvenile treatment and custody facilities; (9) county and municipal courts; (10) recreation facilities; and (11) administrative space.

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[1] Colorado, Governor's Committee on Oil Shale Environmental Problems, Subcommittee on Regional Development and Land Use Planning. Tax Lead Time Study for the Oil Shale Region: Fiscal Alternatives for Rapidly Growing Communities in Colorado. Denver, Colo.: Colorado Geological Survey, 1974; and Bolt, R.M., et al. Boom Town Financing Study, Vol. 1. Denver, Colo.: Colorado Department of Local Affairs, 1976.

[2] We assume that workers will live in the vicinity of their employment. This is certainly the current situation and is likely to be the dominant one for the medium-term future. For information on the origin and location of energy workers in the West, see Mountain West Research. Construction Worker Profile, Final Report. Washington, D.C.: Old West Regional Commission, 1976.

[3] County seats often have judicial and law enforcement facilities for the entire county.

The costs for the set of facilities listed above ranges from $1,500 to $2,300 per new resident. An increase in population of 500 people, for example, will cost a town at least $750,000. Water and sewage treatment facilities typically account for about 75 percent of the total needed for new public facilities. Operating expenditures also increase with additional population, and average about $130 per capita.[2] Operating costs can also involve sudden jumps, for example, to change from a volunteer fire department to a full-time department.[3]

The following section discusses the issues and current responses in local services and facilities in western towns. Financial considerations and planning are the two areas chosen here for special consideration. In addition, water and sewage treatment is discussed separately in the discussion of local financial considerations.

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[1] Bolt, R.M., et al. Boom Town Financing Study, Vol. 1. Denver, Colo.: Colorado Department of Local Affairs, 1976, p. 14. In the original list, primary and secondary classrooms and other educational facilities were designated as the tenth item. This was omitted here because school financing typically is managed exclusively by school districts rather than by municipal, county or multicounty governments (see Mountain West Research. Construction Worker Profile, Final Report. Washington, D.C.: Old West Regional Commission, 1976). Streets and roads are usually maintained, but not built, by local governments.

[2] See Lindauer, R.L. "Solutions to the Economic Impacts of Large Mineral Developments on Local Governments," in Federation of Rocky Mountain States. Energy Development in the Rocky Mountain Region: Goals and Concerns. Denver, Colo.: Federation of Rocky Mountain States, 1975, pp. 63-68; THK Associates, Inc. Impact Analysis and Development Patterns Related to an Oil Shale Industry: Regional Development and Land-Use Study. Denver, Colo.: THK Associates, 1974, pp. 30-41. Costs are in 1975 dollars.

[3] James Conoho, Mayor of Hartsville, Tennessee, testified that changing to a ten-man department will cost his community $100,000 per year. Statement in U.S., Congress, Senate, Committee on Environment and Public Works. Inland Energy Development Impact Assistance Act of 1977. Hearings before the Subcommittee on Regional and Community Development, 95th Congress, 1st session, August 2 and 27, 1977, p. 182. The higher wage levels in western towns would probably require even greater costs, in the area of $150,000 per year.

9.2.1 Financial Problems and Assistance

In the usual energy development situation in the West, energy facilities, such as mines and conversion plants, are located outside of nearby towns. These locations incur an ad valorem or property tax obligation to the county and school district in which the facility is located. The workers at the facilities live in nearby (or more distant) towns, which do not receive a corresponding increase in tax base. In the words of Mayor Richard Waggener of Green River, Wyoming, "The county has the evaluation (sic) we have the people."[1] Municipal revenues are usually based on sales taxes, property taxes on valuation within town boundaries, and other charges and fees that tend to increase with population increases. These revenues may be adequate to cover rising operating costs, but not to fund major capital improvements such as water and sewer facilities. As Mike Enzi, Mayor of Gillette, Wyoming, puts it: "We simply need money (and) reliable information."[2]

Town residents benefit when the school district receiving property tax revenue also serves the town.[3] County governments do provide town residents such services as hospitals, recreation, county roads, and libraries, but little sharing of county wealth occurs for municipal services and facilities, such as water and sewers, city fire and police protection, and sanitation. The City of Gillette is facing an annual deficit of $3-$4 million at least through 1985. Campbell County, on the other hand, expects an increasing surplus beginning in 1979 at the present property tax rate of 5.269 mills; the surplus would be larger if the maximum rate of 12 mills were applied.[1] The situation in Hayden, Colorado, is similar.[2]

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[1] Waggener, Richard W. Prepared Statement in U.S., Congress, Senate, Committee on Environment and Public Works. Inland Energy Development Impact Assistance Act of 1977. Hearings before the Subcommittee on Regional and Community Development, 95th Congress, 1st session, August 2 and 27, 1977, p. 195.

[2] Strabala, Bill. "Officials Eye Coal Concerns." Denver Post, November 17, 1977, p. 4.

[3] This occurs most frequently where there are county-wide school districts. Even in this situation, residents do not always live in the same county (or state) as that in which the energy facility is located. See Section 9.2.

Energy facility construction exacerbates local financial problems. Construction is a short-term, labor-intensive activity that makes it difficult for local governments to anticipate long-term service needs versus temporary needs of a construction-related population. Further, production-based measures such as severance taxes are not available until energy is produced.[3] When construction workers (or others) live in mobile homes, their contribution to the municipal tax base is generally not equal to their demands on local governments.[4] Finally, the fluctuations involved in construction employment when several facilities are built in an area create severe problems for capital facilities in towns. When population growth is erratic, public facilities are unlikely to be available at the needed or most efficient levels for more than short periods of time.[5]

Local governments have little control over the distribution of revenues needed for public services and facilities. Control of property tax revenues perpetuates disparities between towns, on the one hand, and counties and school districts on the other. Wyoming, for example, has recognized the problem by creating a Joint Powers Act that permits cities and counties to act jointly in providing public services and facilities, essentially by extending urban powers to counties when they act with a city.[1] However, the initiative lies with the counties, which are reluctant to become responsible for municipal finances and unwilling to accept liability on debts related to increased town populations.[2] Special service districts for particular services, such as water supply or fire protection, provide a middle ground between local government autonomy and comprehensive joint action. These districts also require cooperation of residents outside of the towns.

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[1] Campbell County Chamber of Commerce. Economic Impact of Anticipated Growth: City of Gillette and Campbell County, Wyoming. Gillette, Wyo.: Campbell County Chamber of Commerce, 1976.

[2] Gits, V. "Boom Town on the Brink." Colorado/Business, Vol. 5 (February 1978), pp. 30-42.

[3] For example, see Guenther, Max, Mayor of Underwood, North Dakota, Statement in U.S., Congress, Senate, Committee on Environment and Public Works. Inland Energy Development Impact Assistance Act of 1977. Hearings before the Subcommittee on Regional and Community Development, 95th Congress, 1st session, August 2 and 27, 1977, pp. 179-181.

[4] This point is elaborated in the discussion of Housing in Chapter 8.

[5] See the fluctuations resulting from the energy development scenarios in White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Chapters 6-11.

A. State Action

Responses to local financial impacts frequently are based on the existing property tax base, rather than on alternatives to it.[3] Prepayment of taxes in Utah[4] and Montana[5] maintains the distinction between municipalities and the jurisdictions within which the energy facilities are located. As a result, the principal benefit is to school districts and county services such as roads; little, if any, revenue is available for municipal services. Experience to date with these measures in the two states is too limited to provide much insight into how effective this legislation will be. A major disadvantage to tax prepayment is that the Internal Revenue Service refuses to allow taxes to be deducted until the year when the payment is due. This significantly decreases the likelihood that voluntary prepayment will be made.[6]

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[1] Daley, J.B. "Financing Housing and Public Facilities in Energy Boom Towns," in Rocky Mountain Mineral Law Foundation. Rocky Mountain Mineral Law Institute: Proceedings of the 22nd Annual Institute, July 22-24, 1976. New York, N.Y.: Matthew Bender, 1976, pp. 123-24.

[2] Bronder, L.D., N. Carlisle, and M.D. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977.

[3] Alternatives to the current methods of local property tax collection are mentioned in Section 8.5 below.

[4] Daley. "Financing Housing," pp. 123-24.

[5] Ibid., pp. 117-19.

[6] Bronder, Carlisle, and Savage. Strategies for Alleviation of Socioeconomic Impacts, pp. 557-58.

States with severance taxes on coal and other energy resources can alleviate the imbalance at the local level by establishing a central collection and disbursement system. Table 9-1 shows the range of severance taxes in the West, and excludes any state receipts of federal mineral royalties. The seven states listed in the table vary considerably in the extent to which they tax energy resource production. For example, given a production level of 100 million tons and an average selling price of $12 per ton, Montana would collect $360 million whereas North Dakota would collect only $50 million. Utah has no severance tax and a constitutional prohibition on state revenue collection for local governments.

From the point of view of local impacts, the more important variation is in the distribution of severance tax revenues to local governments. Two states in our study area, New Mexico and Wyoming, have no specific allocation of mineral revenues to local governments; most of their severance tax transfer is to school districts. Colorado, Montana, and North Dakota all earmark a percentage of their severance tax receipts to local government. The trend among the western states is for the state government to retain the bulk of mineral tax revenues for state purposes, such as the state general fund, capital improvements, and trust funds.[1] The allocation formulas of mineral tax legislation may prove to be inflexible in some cases for dealing with as yet unrealized local impacts. In addition, some towns have difficulty persuading the state [illegible]ursing authority of the magnitude of the population impact th[illegible]ve experienced. For example, Miles City, Montana, has been unable to afford the necessary Special Census to document its recent population growth. As a result, even a relatively effective system like that of the Montana Coal Board has difficulty in dealing with impacts seventy miles or so from the coal mine involved.

State limits on bonding and the debt local governments can incur can hinder local attempts to finance facilities with bonds which would be repaid with future tax revenues. Table 9-2 shows the limitations on bonded debt in six western states. While in some circumstances these limitations are not overly restrictive, they can be too inflexible to meet the needs of energy impact areas, given their lead time problem. Popular support for increasing local debt limitations seems limited, at least in

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[1] The capital improvements authorized tend to include municipal water and sewage treatment facilities, but the emphasis is on roads, highways, schools, and universities. Bronder, L.D., N. Carlisle, and M.D. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977, pp. 557-58.

TABLE 9-1: STATE ENERGY-RELATED TAX REVENUES AND REDISTRIBUTION TO LOCAL GOVERNMENTS, SEVEN WESTERN STATES[a]

STATE	ENERGY MINERAL REVENUES					DISTRIBUTION TO LOCAL GOVERNMENTS
	OIL AND GAS	COAL	MINING	OIL SHALE	OTHER	
Colorado	2%-5% depending on production	30¢/ton UG 60¢/ton surface	$50 plus $15/acre on surface mines annually	Up to 4% of gross proceeds	Oil shale lease royalties	45% of severance tax revenues to local governments; 60% of oil shale lease royalties to local governments thus far
Montana	2.1%-2.65%-oil 2.65%-gas	12¢/ton or 4% UG ; 40¢/ton or 30% surface (whichever is higher)			1.688% of sales of electricity	17% of severance tax revenues to local governments; most goes to trust fund and general fund
New Mexico	3.75%	.05% on new contracts; 17% on old			.04¢/kWh of electricity generated	No requirement on local distribution, but 43% of all state revenues went to local government (primarily schools) in 1975-76
North Dakota	5%	50¢/ton + 1¢ escalator clause geared to wholesale price index			0.25¢/kWh of electricity produced	40% of coal severance tax to local governments; small amount of coal conversion tax, based on complicated framework
Utah						State aid largely to school districts; overall, 32% of state money sent to local government in 1974-75
Wyoming	4%	8.5% + privilege tax of up to 2% until $160 million is raised for capital facilities			5.5% of gross produce on uranium	27% of all state revenues went to local government in 1974-75; little energy-related revenue is earmarked for local government
Arizona			3% of gross value			44% overall to local governments, 5/8 of that to school districts; no energy-related revenue is earmarked for local governments

UG = underground

kWh = kilowatt-hour

Source: Bronder, L.D., N. Carlisle, and M.D. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts of Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977.

[a] This table updates Table 12-39 in White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. II, p. 815.

TABLE 9-2: LIMITATIONS ON BONDED DEBT IN SIX WESTERN STATES
(percent of assessed valuation)

STATES	COUNTIES	MUNICIPALITIES	SCHOOL DISTRICTS
Colorado	1.5	3	20
Montana	2.5	5[a]	-[b]
New Mexico	4	4	6
North Dakota	5	5[c]	5[c]
Utah	2	4	-
Wyoming	2	4[d]	10

- = no restrictions

Source: Compiled from Bronder, L.D., N. Carlisle, and M.D. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977.

[a] May be increased by 10 percent for water and sewer systems.

[b] State makes up shortfalls through statewide levies.

[c] May be increased an additional 3 percent by 2/3 voter approval.

[d] Eight percent limit for sewer projects; no limit on water projects.

Wyoming, where a constitutional amendment to that effect failed to pass in 1976.[1]

Some western states attempt to deal with this problem by having either a state agency or a quasi-governmental entity sell tax-free bonds to finance the construction of local public facilities. Montana's Board of Housing is able to finance community services and facilities, as well as housing, since Montana statutes define housing development broadly to include "streets, sewers, utilities, parks...and other nonhousing facilities as the Board determines to be necessary, convenient, or desirable."[1]

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[1] Savage, M.D. "An Overview of Strategies for Financing the Mitigation of Socioeconomic Impacts," in Bronder, L.D., N. Carlisle, and M.D. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977, pp. 559-60.

B. Federal Actions

Federal programs have been less responsive than state programs to the conditions of energy impact areas. Two well-intended programs based on federal land or mineral ownership are not nearly as effective as they might be. For example, the Public Lands-Local Government Funds Act or "In Lieu of Tax Payment" Act provides payments to local government units in which federal entitlement lands are located.[2] These are almost exclusively county and school district lands, and revenues generally do not go to municipalities. In the Bureau of Land Management (BLM) Organic Act, one-fourth of the royalties (12.5 percent of the total 50 percent that states receive) from federal minerals are earmarked for local governments, and loans may be made for social and economic impacts of energy development in anticipation of future mineral revenues.[3] Loans to municipalities tend to be rather small, because future revenues on which loans can be based are limited. Unlike counties and school districts, municipal revenues are not based on mineral resources. The result, then, is that the loans do little to help to fund the magnitude of services and facilities required.

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[1] Montana Revised Codes Annotated 35-503(8) (Cumulative Supplement 1975); Daley, J.B. "Financing Housing and Public Facilities in Energy Boom Towns," in Rocky Mountain Mineral Law Foundation. Rocky Mountain Mineral Law Institute: Proceedings of the 22nd Annual Institute, July 22-24, 1976. New York, N.Y.: Matthew Bender, 1976, pp. 58-62. In Wyoming, the state supreme court ruled on February 13, 1978 that the Wyoming Community Development Authority was unconstitutional because it would allow bonds to be issued prior to the collection of mineral tax revenues to repay them. See Witzenburger v. State of Wyoming, Wyo. 1978, 575 P.2d 1100.

[2] Public Lands-Local Government Funds Act, Pub. L. 94-565, 90 Stat. 2662, 31 U.S.C. 1601 et seq.

[3] Federal Land Policy and Management Act of 1976, Pub. L. 94-579, 90 Stat. 2743, 43 U.S.C. 1701 et seq. See also Savage, M.D. "An Overview of Strategies for Financing the Mitigation of Socioeconomic Impacts," in Bronder, L.D., N. Carlisle, and M.D. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977, pp. 568-71. In practice, loans have not been made against future revenues because of low interest rates and constitutional prohibitions in some states such as Wyoming.

The federal programs relevant for general funding in energy-impacted areas are primarily loan programs. Some specific programs, such as water and sewage treatment and planning, include grant funds, but the tendency is for general-purpose funding to be based exclusively on loans. The reliance on loans, rather than grants, assumes that the local government will be able to repay in the future.[1] This assumption is valid for many county governments, school districts, and other jurisdictions that have large property tax receipts; it is not true for many towns in the West, where the service needs are greater than in rural areas.

As a result of the lack of a general federal grant program, governors and mayors in the West are speaking out in favor of grants rather than loans. Governor Thomas Judge of Montana maintains that "a limited amount of grant money would be more useful than a great deal of loan money."[2] Local officials also voice support for this view.[3] However, recent proposals indicate a preference for loan and loan guarantee programs on the federal level. Senator Gary Hart of Colorado, author of the Inland Energy Development Impact Assistance Bill (S.1493), comments: "A bill, based on a grant program, particularly a 100 percent grant program, has very questionable chances of enactment in the near-term."[4] Even the tendency for federally guaranteed loans is coming into question. Guaranteed loans currently outstanding for all existing programs are estimated to total $277 billion, and President Carter would like to limit the spread of loan guarantees.[5]

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[1] U.S., Department of Energy, Energy Impact Assistance Steering Group. Report to the President on Energy Impact Assistance, Draft Report. Washington, D.C.: U.S., Department of Energy, 1977.

[2] Judge, Thomas L., Governor of Montana. Statement in U.S., Congress, Senate, Committee on Environment and Public Works. Inland Energy Development Impact Assistance Act of 1977. Hearings before the Subcommittee on Regional and Community Development, 95th Congress, 1st session, August 2 and 27, 1977, p. 47.

[3] Webb, Marlo L., Mayor of Farmington, New Mexico; Jim Young, County Commissioner, San Juan County, New Mexico; and Fred L. O'Chesky, Energy Resources Administrator, State of New Mexico. Statements in Senate Committee on Environment and Public Works. Inland Energy Act of 1977. Hearings, pp. 377-419.

[4] Hart, Gary, Senator, Colorado. Statement in Senate Committee on Environment and Public Works. Inland Energy Act of 1977. Hearings, p. 48.

[5] "A Lid on U.S. Loan Guarantees." Business Week, January 30, 1978, p. 64.

While state and local government officials agree on the need for grants, they do not agree on how the grants should be distributed. Local governments in most cases greatly prefer to receive federal money directly instead of having the funds going through the state governments. Mayor Larry Kozisek of Grand Junction, Colorado, attributes this to a lack of concern from state officials and the minimal political clout that rural areas and small towns have at the state level.[1] He cites delays in state distribution of federal funds, and the allocation of a large portion of federal assistance to counties rather than to municipalities.[2]

State officials, as might be expected, support funneling the federal assistance through the states[3] or through the Title V Regional Commissions in which the states play a major role.[4] The Hart bill, mentioned above, calls for state control over funds.[5]

C. Water and Sewage Treatment

Water and sewage treatment facilities are the largest expenditure items among municipal facilities. Sewage treatment is almost exclusively a municipal function, since few areas in the West outside of towns have public sewage service. In addition to needs for expanding water supply and sewage treatment facilities as a consequence of population growth, recent water pollution legislation requires that existing public treatment works install secondary waste treatment by 1977 (now delayed until 1983)[6] and

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[1] Kozisek, Larry, Mayor of Grand Junction, Colorado. Statement in U.S., Congress, Senate, Committee on Environment and Public Works. Inland Energy Development Impact Assistance Act of 1977. Hearings before the Subcommittee on Regional and Community Development, 95th Cong., 1st sess., August 2 and 27, 1977, p. 178.

[2] *Ibid.*, pp. 220-33.

[3] Link, Arthur A., Governor of North Dakota. Statement in Senate Committee on Environment and Public Works. Inland Energy Act of 1977. Hearings, pp. 42-44.

[4] Judge, Thomas L., Governor of Montana. Statement in Senate Committee on Environment and Public Works. Inland Energy Act of 1977. Hearings, pp. 44-48.

[5] Hart, Gary, Senator, Colorado. Statement in Senate Committee on Environment and Public Works. Inland Energy Act of 1977. Hearings, pp. 1974-75.

[6] Clean Water Act of 1977, Pub. L. 95-217, 91 Stat. 1566, U.S.C. §§ 1251 *et seq*.

"best practicable" waste treatment technologies by 1983.[1] A goal of the law is to prevent the discharge of pollutants to local streams after 1985. These requirements apply nationwide.[2]

As shown in Table 9-3, over one-half of the towns affected by western energy development either lack a water or sewer system or have reached capacity in their existing systems. Upgrading treatment works to the new standards adds to local governments' financial burdens.

Upgrading treatment facilities is aided by the Wastewater Construction Grants Program, administered by the Environmental Protection Agency (EPA). Various delays and complicated administrative procedures in the program have been blamed for the delays in meeting the 1977 deadline.[3]

The Construction Grants Program, the largest recent public works program in the U.S., is intended to help communities meet the costs of new treatment works. Through fiscal year 1976, the eight western states had received only 1.55 percent of the total national funds for the program (Table 9-4); the eight states account for about 4 percent of the nation's population. The Construction Grant Program appears to be aimed more at large cities than at small towns, since large cities are somewhat favored by procedures that allow metropolitan communities to apply directly to EPA, whereas nonmetropolitan communities are required to go through a state agency for funds (see box).

OUT OF STEP

Mayor Mike Enzi of Gillette, Wyoming has a string of stories to tell about being turned down for federal money. EPA rejected a request for sewage treatment facilities because Gillette already had a treatment plant and must wait until 27 other towns in Wyoming get their first ones. Most other economic assistance is intended for urban areas and high-unemployment areas, not for areas with growth and low unemployment such as Gillette.

--Enzi, M.B. "Energy Boom: Wyoming's Coal Veins Just Bring Troubles." Los Angeles Times, May 15, 1977, p. V-3.

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[1] Federal Water Pollution Control Act Amendments of 1972. Pub. L. 92-500, 86 Stat. 816, 33 U.S.C. §§ 1251 et seq.

[2] Clean Water Act of 1977, Pub. L. 95-217, 91 Stat. 1566, 33 U.S.C. §§ 1251 et seq.

[3] U.S., Council on Environmental Quality. Environmental Quality: Sixth Annual Report. Washington, D.C.: Government Printing Office, 1975, pp. 71-72; Kirschten, J. Dicken. "Plunging the Problems from the Sewage Treatment Grant System." National Journal, Vol. 9 (February 5, 1977), pp. 196-202.

TABLE 9-3: NUMBER OF COMMUNITIES IN SIX WESTERN STATES, REGION VIII, WITH NO WATER OR SEWAGE SYSTEM OR SYSTEM AT CAPACITY

	COLORADO	MONTANA	NORTH DAKOTA	SOUTH DAKOTA	UTAH	WYOMING	TOTAL
Water Treatment							
No system[a]	0	11	5	3	47	8	74
At or over 100% of capacity	12	2	4	0	--	5	23
Incomplete data	1	1	2	0	9	8	21
							118
Sewage Treatment							
No system[b]	5	6	2	0	32	4	49
At or over 100% of capacity	11	5	1	0	10	15	42
Incomplete data	0	2	9	1	1	7	20
							111
Number of communities considered	38	23	29	5	56	37	188

Source: U.S., Federal Energy Administration, Region VIII, Socioeconomic Program Data Collection Office. Regional Profile: Energy Impacted Communities. Lakewood, Colo.: Federal Energy Administration, 1977.

[a] A few communities have only private wells.

[b] A few communities have private septic tanks or lagoon systems only.

TABLE 9-4: SEWAGE TREATMENT CONSTRUCTION GRANTS--ALLOTMENTS TO WESTERN STATES, FISCAL YEARS 1973-1976

STATE	TOTAL ALLOTMENT (millions of dollars)	PERCENT
Arizona	43.6	0.24
New Mexico	36.3	0.20
Colorado	89.9	0.50
Montana	28.2	0.16
North Dakota	12.0	0.06
South Dakota	17.7	0.10
Utah	45.0	0.25
Wyoming	8.3	0.05
Total	281.1	1.56
National Total	18,000.0	100.0

Source: U.S., Environmental Protection Agency, as reported in Kirschten, J.D. "Plunging the Problems from the Sewage Treatment Grant System." National Journal, Vol. 9 (February 5, 1977), pp. 196-202.

One intent of federal water pollution restrictions is to reduce large-city pollution problems. This is borne out by the greater allocations of funds to the more urbanized states. Likewise, the construction grant program is a massive public works effort that provides employment for construction workers in large cities.[1] It is not unusual for federal legislation to focus on large city problems, such as the establishment of the Urban Mass Transit Administration and the Department of Housing and Urban Development (HUD). However, conflicts among large northeastern, southern, and western cities and towns over the distribution of federal funds to each region are increasing.[1] Any change in the EPA pollution regulations or grants allocation to favor small western towns over northeastern cities probably would give rise to substantial regional conflict. The state priority systems for EPA grants to nonmetropolitan communities tend to put towns that have recently received funds far down on the list for future funds. Water and sewer systems in towns where growth has continued, such as Gillette, remain overburdened.[2]

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[1] Kirschten, J. Dicken. "Plunging the Problems from the Sewage Treatment Grant System." National Journal, Vol. 9 (February 5, 1977), pp. 196-202.

When EPA grant funds are not available to meet continuing needs, towns may sometimes obtain assistance from agencies other than EPA. The Economic Development Administration (EDA) and the Title V Regional Commissions have frequently provided grants to communities for water and sewage treatment plants. The EDA commonly does this under the Special Economic Development and Adjustment Assistance Program (Economic Adjustment Program).[3] Beulah, North Dakota, and Carbondale, Utah, are among the western towns to receive construction grants from EDA.[4] Applications to EDA from small towns need not go through a state agency, which often makes funds available quickly.

State funding has also helped some towns meet their water and sewer system needs. For example, over $3 million of the $11.6 million allocated by the Montana Coal Board through March 1977 to Big Horn, Rosebud, and Treasure Counties was for water and sewer projects.[1] The state of Wyoming also has allocated coal tax grants to Wyoming communities, several for water and sewer facilities.[2]

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[1] "The Second War Between the States." Business Week, May 17, 1976, pp. 92-114; Peirce, N.R. "Northeast Governors Map Battle Plans for Fight over Federal Funds Flow." National Journal, Vol. 8 (November 27, 1976), pp. 1695-703; Havemann, J., and R.L. Stanfield. "A Year Later, the Frostbelt Strikes Back." National Journal, Vol. 9 (July 2, 1977), pp. 1028-37.

[2] Enzi, M.B. "Energy Boom: Wyoming's Coal Veins Just Bring Troubles." Los Angeles Times, May 15, 1977, p. V-5; and Pernula, Dale. City of Gillette/Campbell County: 1977 Citizen Policy Survey. Gillette, Wyo.: Gillette/Campbell County Department of Planning and Development, 1977.

[3] Public Works and Economic Development Act of 1965, Pub. L. 89-136, 79 Stat. 552, 42 U.S.C. 3241, 3243, 3245.

[4] U.S., Federal Energy Administration. Socioeconomic Impacts and Federal Assistance in Energy Development Impacted Communities, Federal Region VIII. Denver, Colo.: Federal Energy Administration, 1976. However, both EPA and EDA had rejected Gillette, Wyoming's request for funds for treatment facility expansion. See Enzi. "Energy Boom."

9.2.2 Health Services and Social Services

A. Medical Care

Adequate health services are among the most difficult to provide in rapid growth situations that accompany energy development. Medical needs typically expand at least as rapidly as the population, and even faster when a large proportion of the new residents are children, as is commonly the case in communities affected by energy development.[3] Limited health services can result in a smaller proportion of children being immunized against preventable diseases, fewer screening tests for tuberculosis and other diseases, and less followup on active cases of tuberculosis and venereal disease. Inability to obtain early treatment can permit other diseases to become more serious.[4]

A shortage of doctors is a common problem. Many small towns have no doctor; even fewer communities have a hospital (Table 9-5). Frequently the only hospital is in the county seat, and long distances separate other towns. The doctor/population ratios are much lower in western towns than in the country generally. For example, Gillette has a ratio of less than one doctor per 900 people, compared to the national average of one per 660 people.[5] Public health clinics with staff nurses often supplement the medical system.

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[1] Bronder, L.D., N. Carlisle, and M.D. Savage. Financial Strategies for the Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977, pp. 129-34.

[2] Ibid., pp. 376-92.

[3] Mountain West Research. Construction Worker Profile, Final Report. Washington, D.C.: Old West Regional Commission, 1976.

[4] Copley International Corp. Health Impacts of Environmental Pollution in Energy-Development Impacted Communities, Executive Summary, for the Environmental Protection Agency. La Jolla, Calif.: Copley International, 1977.

[5] White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. II, p. 521.

TABLE 9-5: NUMBER OF TOWNS WITH A DOCTOR AND WITH A HOSPITAL AMONG ENERGY-IMPACTED COMMUNITIES IN SIX WESTERN STATES

STATE	TOTAL NUMBER OF IMPACTED COMMUNITIES	NUMBER OF TOWNS WITH A DOCTOR	NUMBER OF TOWNS WITH A HOSPITAL
Colorado	56	24	16
Montana	23	11	9
North Dakota	28	10	7
South Dakota	4	5	4
Utah	56	18	11
Wyoming	36	19	13
Total	185	87	60

Source: U.S., Federal Energy Administration, Region VIII, Socioeconomic Program Data Collection Office. Regional Profile: Energy Impacted Communities. Lakewood, Colo.: Federal Energy Administration, 1977. Communities over 40,000 population were excluded from this table.

The shortage of doctors in small towns is not unique to the West, but it is exacerbated by increasing medical needs caused by energy development. Medical care is largely a private enterprise. Hospitals and clinics may be available, but doctors must be attracted to set up small town practices instead of large city locations with full-service hospitals.[1] One of the serious quality-of-life impacts in energy boomtowns is the added difficulty of attracting doctors to those locations.[2] Getting nurses to work in rural areas appears to be less of a problem, but it is more severe in energy-impacted communities.[1]

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[1] Coleman, Sinclair. Physician Distribution and Rural Access to Medical Services, R-1887-HEW. Santa Monica, Calif.: Rand Corporation, 1976; Lankford, Phillip L. "Physician Location Factors and Public Policy." Economic Geography, Vol. 50 (July 1974), pp. 244-45.

[2] U.S., Department of Energy, Energy Impact Assistance Steering Group. Report to the President on Energy Impact Assistance, Draft Report. Washington, D.C.: U.S., Department of Energy, 1977.

Although medical care is largely a private-sector service, all levels of government have taken part in programs to provide care to the population. County governments generally provide some funds from property tax receipts for county hospitals and clinics. Local governments in Colorado and North Dakota also provide funds for emergency medical services (EMS) in rural areas to supplement EMS grants from the U.S. Public Health Service.[2] In the other states, state funds generally support EMS programs, which are very extensive in most western states.[3] In many cases, priorities imposed at federal and state levels for health planning preclude adequate attention to substate areas in health planning. Health planning tends to be done either very locally or statewide, and neither scope provides effective planning considerations for energy impact areas.[4]

The U.S. Public Health Service's National Health Service Corps (NHSC) is designed specifically to improve the delivery of health care and services to residents in areas critically short of health personnel.[5] The NHSC is utilized in all eight western states in an attempt to provide medical services in towns where a practicing physician is not present. NHSC personnel are assigned for only two years, so recruitment of doctors must be repeated frequently.[6]

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[1] Sloan, E.A. The Geographic Distribution of Nurses and Public Policy. Washington, D.C.: Government Printing Office, 1975, pp. 141-55; Rapp, Donald A. Western Boomtowns, Part I, Amended: A Comparative Analysis of State Actions, Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, pp. 24-27.

[2] Emergency Medical Services Systems Act of 1973, Pub. L. 93-154, 87 Stat. 594, as amended by Pub. L. 94-573, 90 Stat. 2709.

[3] Rapp. Western Boomtowns, pp. 23-27.

[4] Copley International Corp. Health Impacts of Environmental Pollution in Energy-Development Impacted Communities, Executive Summary, for the Environmental Protection Agency. La Jolla, Calif.: Copley International, 1977, p. 25.

[5] Emergency Health Personnel Act Amendments of 1972, Pub. L. 92-585, 86 Stat. 1290, 42 U.S.C. 254b.

[6] Rapp. Western Boomtowns, pp. 23-27.

State loan programs for medical training are beginning to include loan forgiveness programs to induce doctors to locate in rural areas. This approach has been cited as the most effective public policy means of attracting doctors away from large city locations.[1]

B. Social Services

Among the services most needed in boomtown situations are social services, such as treatment and counseling for alcoholism, child abuse, and juvenile delinquency. These services are often not included in communities where the population has been stable for many years, but become necessary as rapid growth and an influx of newcomers disrupts a stable society.[2] Urban growth alone spurs demands for social services, as a larger number of people need such services. These services generally require little in the way of capital facilities, but they do require a continuing operating cost for professional staff members. The benefit from a social service program has been well-documented from the experience of the Wyoming Human Services project, which had social service teams in Gillette for several years and, more recently, in Wheatland.[3]

The problem of inadequate social services has received less attention than the more costly municipal facilities. However, the problem has received recognition from New Mexico Governor Jerry Apodoca: "Impact assistance should not be limited to traditional infrastructure needs such as water and sewer, but should extend to health, housing, social services, and other areas."[4]

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[1] Coleman, Sinclair. Physician Distribution and Rural Access to Medical Services, R-1887-HEW. Santa Monica, Calif.: Rand Corporation, 1976.

[2] Kneese, Allan V. "Mitigating the Undesirable Aspects of Boom Town Development," in Federation of Rocky Mountain States. Energy Development in the Rocky Mountain Region: Goals and Concerns. Denver, Colo.: Federation of Rocky Mountain States, 1975, pp. 74-76; Richards, Bill. "Western Energy Rush Taking Toll Among Boom Area Children." Washington Post, December 13, 1976, pp. 1, 4.

[3] Uhlmann, Julie M. Gillette Human Services Project, Annual Report, August 31, 1976. Laramie, Wyo.: University of Wyoming, Wyoming Human Services Project, 1976.

[4] Apodoca, Jerry, Governor of New Mexico. Statement in U.S., Congress, Senate, Committee on Environment and Public Works. Inland Energy Development Impact Assistance Act of 1977. Hearings before the Subcommittee on Regional and Community Development, 95th Congress, 1st session, August 2 and 27, 1977, p. 78.

All eight states, except Wyoming, have state-funded mental health, alcohol, and drug abuse programs, but they have been inadequate due to insufficient funding.[1]

Energy companies have contributed to social services in some western communities. The Missouri Basin Power Cooperative and Atlantic Richfield Company have provided support for the Wyoming Human Services Project in Wheatland and Gillette, respectively. A general reluctance on the part of energy companies to assist communities, noted a short time ago,[2] is probably beginning to change.

9.2.3 Planning Responses

Planning is a necessary part of any response to rapid growth. In western energy development, nearby towns are especially affected. Communities commonly have land-use plans which include zoning regulation and capital facility plans, including, for example, plans for streets, water and sewer lines, and firehouses. When a small town is impacted by energy development, existing plans quickly become inadequate. The most basic lack in planning for energy impacts is adequate and timely information. Local government officials often do not have access to critical planning information, such as construction schedules, accurate employment estimates, and projected capital investment.[3] It is admittedly difficult for energy firms to provide this information, since they must deal with uncertainties involved in markets, suppliers, and government regulations.[4] As a result, the interaction between the private and public sectors in energy-impact areas is frequently not sufficient to solve the growth-related problems of energy development.[1]

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[1] Rapp, Donald A. Western Boomtowns, Part I, Amended: A Comparative Analysis of State Action, Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, p. 23.

[2] Arthur Young and Company. Problems on Financing Services and Facilities in Communities Impacted by Energy Resource Development. Washington, D.C.: Arthur Young, 1976.

[3] Bolt, R.M., et al. Boom Town Financing Study. Denver, Colo.: Colorado Department of Local Affairs, 1976, Vol. 1, pp. 40-41; and Schnidman, Frank. Awareness and Perception of the States to Local and Regional Needs Created by Energy Production or Extraction Facilities, for the U.S. Department of Housing and Urban Development. Washington, D.C.: Urban Land Institute, 1977.

[4] See the discussion of this point in Chapter 10, Capital Availability, and Chapter 12, Energy Facility Siting.

The extent of the planning problem is indicated by the designation of 188 communities in Federal Region VIII as impacted by energy resource development.[2] A common element among these communities is a general lack of capacity of the local governments to deal with growth. Table 9-6 shows the absence of municipal staff people (notably planners) who generally are needed to manage growth, particularly rapid growth. Municipal administrations and staff also add to operating expenditures of money-short communities.

Planning generally includes two principal activities: land-use planning and management or program planning. Both activities in energy areas require information concerning the scheduling, magnitude, and related impacts of energy development. Land-use planning is the common concern of the planning profession, especially for urban regions. In small western towns, program planning is at least as important, requiring budget priorities, the sequence of projects, and the identification of revenue sources to meet needs. These two types of planning are discussed in turn below.

A. Land-Use Planning

The lack of land-use controls at the local level is a pervasive condition in the West. Most incorporated municipalities have zoning ordinances, building codes, and subdivision regulations (Table 9-7), but land-use control outside of municipalities is rare.[3] Towns can zone only within their boundaries, and county-wide plans (if they exist) frequently remain unenforced and

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[1] There are notable exceptions, such as Energy Fuels Company, which has contributed 30 percent of the salary for the first city manager in Hayden, Colorado. See Gits, V. "Boom Town on the Brink." Colorado/Business, Vol. 5 (February 1978), pp. 30-42.

[2] U.S., Federal Energy Administration, Region VIII, Socioeconomic Program Data Collection Office. Regional Profile: Energy Impacted Communities. Lakewood, Colo.: Federal Energy Administration, 1977. The other two states in our study area, Arizona and New Mexico, are in Federal Region X and VI, respectively. These regions have not done similar studies of their states.

[3] Building codes and zoning regulations are more common in larger towns, but comprehensive or master plan documents are less frequent than individual regulations. Many of the existing plans are over ten years old, making them of questionable usefulness in a time of rapid community change.

TABLE 9-6: ADMINISTRATIVE, OPERATIONAL, AND PLANNING CAPACITY OF IMPACTED COMMUNITIES IN SIX WESTERN STATES

STATES	NUMBER OF IMPACTED COMMUNITIES	MAYOR FULL-TIME/PART-TIME			MANAGER FULL-TIME/PART-TIME			ENGINEER FULL-TIME/PART-TIME			PLANNER FULL-TIME/PART-TIME		
Colorado	38	1		36	16		-	14		10	9		2
Montana	23	2		11	-		-	3		5	3		5
North Dakota	29	-		28	-		-	1		2	3		-
South Dakota	5	1		4	1		-	2		-	1		1
Utah[a]	56		(4)			(8)			(6)			(49)	
Wyoming	37	9		26	6		-	7		15	8		6
TOTAL	188	13	(4)	105	23	(8)	0	27	(6)	32	24	(49)	14

- = none

Source: U.S., Federal Energy Administration, Region VIII, Socioeconomic Program Data Collection Office. Regional Profile: Energy Impacted Communities. Lakewood, Colo.: Federal Energy Administration, 1977.

[a] Utah communities did not distinguish between full-time and part-time personnel, so these categories are combined in parentheses.

TABLE 9-7: EXISTING PLANNING MECHANISMS IN SIX WESTERN STATES

STATE	NUMBER OF TOWNS WITH:				NUMBER OF TOWNS CONSIDERED
	PLANNING DOCUMENT	BUILDING CODES	ZONING ORDINANCE	SUBDIVISION REGULATION	
Colorado	19	27	22	21	38
Montana	4	10	9	12	23
North Dakota	6	22[a]	23[a]	16[a]	29
South Dakota	4	4	5	4	5
Utah	17[b]	8	17	6	56
Wyoming[c]	20	27	23	21	37
Total	70	98	99	80	188

Source: U.S., Federal Energy Administration, Region VIII, Socioeconomic Program Data Collection Office. Regional Profile: Energy Impacted Communities. Lakewood, Colo.: Federal Energy Administration, 1977.

[a] Including towns in the process of developing codes in 1977.

[b] All other Utah towns were listed as unknown on this item.

[c] Four Wyoming communities furnished incomplete information on these items.

unenforceable. Rural residents, especially landowners, in the West strongly believe in personal sovereignty over one's land and resist planning that suggests or embodies governmental control of private property.[1] Land-use planning as an activity is accepted in the West, especially if funded from elsewhere (such as federal programs discussed below), but regulation on the basis of a plan is much less common.

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[1] Lamont, W., and M.B. Jones. Land-Use Planning in the Rocky Mountain Region. Denver, Colo.: Federation of Rocky Mountain States, 1976; Christiansen, Bill, and Theodore H. Clack, Jr. "A Western Perspective on Energy: A Plea for Regional Energy Planning." Science, Vol. 194 (November 5, 1976), pp. 578-84. The view against zoning as an infringement of landowners' property rights is not unique to the rural west. The city of Houston, for example, has no zoning regulations. See Siegan, B.J. Other People's Property. Lexington, Mass.: D.C. Heath, 1976.

Zoning and other land-use controls also have their problems.[1] Zoning is a mechanism that depends on prior decisions regarding the appropriate use of land. However, rezoning, variances, and exceptions tend to be the rule as better or more opportune uses of land arise.[2] Zoning also is unable to undo past mistakes since it must recognize the prior rights of existing uses. New or modified zoning may not be retroactive and nonconforming uses typically are allowed to remain. Further, zoning requires an intricate administration that can absorb planning staff time, thus neglecting general or comprehensive planning that reflects community values.

Planning is common at the state level in the West. In particular, Colorado, Montana, and North Dakota have statewide control structures for land-use planning and regulation.[3] The other states in the study area largely allow local landowners (who influence county commissions) to choose whether to adopt or avoid land-use controls. (As discussed above, they usually avoid them or adopt unenforceable planning mechanisms.) However, all eight states have a department responsible for some degree of state planning, technical assistance to local governments for assistance in obtaining state and federal aid, planning, and community development (Table 9-8). The same agency frequently serves as state administering agency for federal grants under HUD's 701 program (discussed in more detail below). Furthermore, all of the states except Wyoming are divided into multicounty planning districts or regions, although in some states, such as New Mexico, regional planning organizations are not active. However, the states typically have minimal or no standards for assuring the qualifications of local or regional planning staffs using state money. As a

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[1] These arguments are taken from Woolfe, D.A. "Zoning is Doing Planning In." Practicing Planner, Vol. 6 (June 1976), pp. 10-13.

[2] Other responses such as condemnation are comparatively rare.

[3] Lamont, W., and M.B. Jones. Land-Use Planning in the Rocky Mountain Region. Denver, Colo.: Federation of Rocky Mountain States, 1976.

TABLE 9-8: STATE PLANNING AGENCIES

STATE	AGENCY	STATE OFFICE ADMINISTERING HUD 701 GRANTS
Arizona	Department of Economic Planning and Development	Same
Colorado	Department of Local Affairs	Colorado Division of Planning
Montana	Department of Community Affairs	Same
New Mexico	State Planning Office	Same
North Dakota	State Planning Division	Same
South Dakota	State Planning Agency	State Planning Bureau
Utah	Department of Community Affairs	State Planning Coordinator (Governor)
Wyoming	Department of Economic Planning and Development	State Planning Coordinator (Governor)

HUD = Department of Housing and Urban Development

result, state efforts to promote sound local planning efforts have been handicapped.[1]

State attempts to plan on a statewide basis or to oversee local planning efforts are becoming more common. However, state actions often conflict with local desires, as illustrated by long-time conflicts between Western Slope communities in Colorado and state agencies in Denver.[2] State agencies also are generally not sufficiently coordinated to deal with a wide range of local problems such as those that result from energy development.[1]

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[1] Rapp, Donald A. Western Boomtowns, Part I, Amended: A Comparative Analysis of State Actions, Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, pp. 42-43.

[2] Kozisek, Larry, Mayor of Grand Junction, Colorado, Statement in U.S., Congress, Senate, Committee on Environmental and Public Works. Inland Energy Development Impact Assistance Act of 1977. Hearings before the Subcommittee on Regional and Community Development, 95th Congress, 1st session, August 2 and 27, 1977, pp. 220-33.

The federal government has a large role in local land-use planning, primarily through financial support for planning and legislated planning requirements, such as EPA's Water Quality Management Program. The HUD Comprehensive Planning Grants (701) Program is the principal source of federal support for local land-use planning.[2] The objective of 701 is to strengthen planning and decisionmaking capabilities of governors, local governments, and area-wide planning organizations, and thereby promote more effective use of the nation's physical, economic, and human resources. All local governments except metropolitan cities and counties and councils of government (COG's) must apply through their state planning agency, which allocates funds received from HUD. Thus all impacted communities in the eight western states must receive these funds through their state agencies or COG's. Of about $60 million funded nationally for 701 planning in 1975, about $630,000 went to impacted communities in six of the eight states in the study area.[3]

The 701 program has assisted in the majority of planning efforts undertaken nationwide in the past few years. The funding has been increased to provide planning funds to many communities as well as to multijurisdictional planning regions such as COG's where planning was not common. In addition, the program promotes and supports continuous management or process-oriented planning.[4]

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[1] Lamont, W., and M.B. Jones. Land-Use Planning in the Rocky Mountain Region. Denver, Colo.: Federation of Rocky Mountain States, 1976; Rapp, Donald A. Western Boomtowns, Part I, Amended: A Comparative Analysis of State Actions, Special Report to the Governors. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976, pp. 40-46.

[2] National Housing Act of 1954, Pub. L. 83-438, 68 Stat. 320, 12 U.S.C. 24, 1430 et seq., as amended, 40 U.S.C. 461, 42 U.S.C. 1407 et seq. See also Wachs, M.W. "Planning for Energy Needs: 701 Helps Meet the New Challenge." HUD Challenge, June 1976, pp. 18-21.

[3] U.S., Federal Energy Administration. Socioeconomic Impacts and Federal Assistance in Energy Development Impacted Communities, Federal Region VIII. Denver, Colo.: Federal Energy Administration, 1976. More recent data have not been compiled for the West.

[4] Lamont and Jones. Land-Use Planning.

However, the plans produced with 701 funds need not be enforced by any level of government, and may tend to merely reference documents for a community's professional planners.

EPA's 208 Water Quality Management Planning Program provides funding for comprehensive planning on a statewide or area-wide basis with an emphasis on improvement of water quality and control of point and nonpoint pollution sources.[1] Area-wide and state planning agencies must develop water quality management plans that include regulatory programs to control the location, modification, and construction of facilities that can result in pollution and programs (including land-use requirements) to control runoff and other pollution from agriculture, mining, forestry, construction, and urban stormwater.[2] In effect, the 208 program requires land-use planning indirectly as one means of achieving the program's goals.[3]

Although the 208 planning program requires that 208 plans be implemented[4], it is not yet clear what this means in practice, because no funding is included for enforcement in the 208 program. A 208 plan may be able to take priority over any other plan for an area within its planning boundaries, which in some cases are entire states. Federal approvals or funding for projects could possibly be withheld if the plan is not adhered to. The states may be ultimately required to enforce the 208 plans within their boundaries for EPA, but this is not yet the case.

In addition to HUD and EPA, EDA in the Department of Commerce has a number of programs that provide planning assistance to state and local government and Indian nations.[1] These generally tend to supplement other federal programs, but they have become very important to some governments, such as the Navajo Nation.[2] Technical Assistance Grants that provide skilled professionals have been widely used in the West, particularly in Colorado, North Dakota, and by the Navajo Nation.

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[1] Federal Water Pollution Control Act of 1972, Pub. L. 92-500, 86 Stat. 816, 33 U.S.C. § 1288. See also U.S., Environmental Protection Agency. EPA Programs in Support of State, Regional, and Local Planning. Washington, D.C.: Environmental Protection Agency, 1976.

[2] Donley, D.L., and K.L. Hall. "Section 208 and 303 Water Quality Planning and Management: Where Is It Now?" Environmental Law Reporter, Vol. 6 (October 1976), pp. 165-70.

[3] Supalla, R.J. "Land Use Planning: An Institutional Overview." American Journal of Agricultural Economics, Vol. 58 (December 1976), pp. 895-901.

[4] Donley and Hall. "Sect. 208 and 303 Water Quality Planning;" and 40 C.F.R. § 131-20(h).

Indian tribes are a unit of local government eligible for any of the federal programs described above as well as for several special loan and grant programs. Many of the special programs are administered by the Bureau of Indian Affairs (BIA). Road construction and maintenance, school construction, and housing development grants all are available through the BIA.[3] As described above, the BIA has provided considerable assistance to Indians in the form of planning and technical assistance grants.

B. Program and Financial Planning

The priorities for a community's attention and revenue change at a rapid rate in energy development situations. As one need is taken care of, another equally important "brushfire" usually awaits attention. The unstable pattern of population which communities experience because of large construction projects inflates temporary facility and service needs beyond those projected for the long term. These short-term needs make planning for public facilities difficult, because it is possible to overbuild if the long-term population level is uncertain.[4]

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[1] Economic Development-Support for Planning Organizations, for redevelopment areas, Pub. L. 89-136, 42 U.S.C. §§ 3151, 3152; and the State and Local Planning Program, for state and local governments, Pub. L. 89-136, U.S.C. §§ 3121 *et seq*.

[2] Navajo Tribe, Office of Program Development. *The Navajo Nation Overall Economic Development Program, 1976 Annual Report*. Window Rock, Ariz.: Navajo Tribe, Office of Program Development, 1976.

[3] U.S., Office of Management and Budget. *Catalog of Federal Domestic Assistance*. Washington, D.C.: Government Printing Office, annually.

[4] This situation is discussed in several of the scenarios in White, Irvin L., *et al*. *Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development*. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. II.

In many cases, it is more practical to provide only temporary facilities for short-term needs.[1] Planning for such needs, and not greatly overestimating or underestimating, requires substantial accurate information from energy developers. The information, which should provide a fairly accurate schedule for each of several developments, is not uniformly complete from all developers. This results in substantial information gaps for local planners and greatly hinders planning.

A final significant problem lies in the possibilities of state or federal funding. The time when promised funds will be received is rarely predictable, and even eligibility for some funds is uncertain or difficult to assess.[2] As a result, program planning currently is done largely on an ad hoc basis as possibilities and conditions change. Finally, the choice between state or federal funds may be made on the basis of such factors as the ability to hire local people for planning, rather than having to accept state personnel who are not committed to the local area.[3]

One mechanism for dealing with information gaps and local impacts on communities is comprehensive facility siting legislation. Private industry can be induced by state legislation, for example, to take an active role in impact assistance to communities. The Wyoming Industrial Siting Administration (WISA) concentrates on mitigation of socioeconomic impacts as a condition for siting permits for large energy and industrial facilities. After studies and hearings by state agencies and local community, a siting permit can be issued with conditions specifying the impact mitigation required.[4] In the only application processed through mid-1977, Basin Electric Power Cooperative agreed to provide 37 specific types of impact alleviation amounting to several million dollars for capital and operating costs as well as housing in connection with its power plant near Wheatland, Wyoming.[1]

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[1] Howard, Needles, Tammen, and Bergendoff. Temporary/Mobile Facilities for Impacted Communities. Washington, D.C.: Old West Regional Commission, 1976.

[2] Enzi, M.B. "Energy Boom: Wyoming's Coal Veins Just Bring Troubles." Los Angeles Times, May 15, 1977, p. V-5.

[3] This point has been mentioned by officials in western Colorado and Montana.

[4] Industrial Development Information and Siting Act of 1975, Wyoming Statutes 35-502.75 *et seq*. (Cumulated Supplement 1975).

This approach allows industry to propose mitigation measures in its own way or to the point where a permit is granted. The law has not yet been tested with investor-owned utilities which, unlike co-ops, may not be permitted to include impact mitigation costs in their rate base as a cost of doing business.

9.2.4 Summary of Local Services and Facilities Issues

Local services and facilities are in short supply and are difficult to plan for in energy-impacted areas because of several factors, including: (1) rapid and unstable population growth; (2) a shortage of information about the timing, magnitude, and location of impacts; (3) a lack of local funds in the towns, where they are most needed; (4) a lack of adequate state and federal programs to provide financial assistance to communities; and (5) a shortage of staff expertise to deal with requirements for federal and state programs.

Some particular issues that have arisen in the West as a result of energy development are:

- Persisting revenue imbalances between counties and school districts which receive revenues from energy facilities, and municipalities which experience most of the population growth impacts but receive little additional revenue.
- Generally inadequate public and private sector cooperative planning, particularly developers dealing only with their employees rather than with overall energy impacts that include service workers.
- Conflict between state and local governments over direct access to federal funds. Most federal guidelines require small towns to apply through state agencies, which many town officials believe are unresponsive to local needs.

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[1] Wyoming Industrial Siting Administration, Docket No. WISA-75-3. See also Valeu, R.L. "Financial and Fiscal Aspects of Monitoring and Mitigation." Paper presented at the Symposium on State-of-the-Art Survey of Socioeconomic Impacts Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977.

9.3 ALTERNATIVE POLICIES AND IMPLEMENTATION STRATEGIES FOR GROWTH MANAGEMENT

9.3.1 Introduction

The discussion in the previous two sections leads to the conclusion that policymakers basically confront two kinds of growth management problems and issues as a consequence of energy resource development in the West: inadequate funding for meeting the community services and facilities needs of a greatly increased population; and a lack of planning expertise and information. In dealing with these problems and issues, policymakers can attempt to achieve two policy objectives. First, they can attempt to ensure that funds available to energy-impacted communities are adequate to provide services and facilities at a level which will minimize the adverse quality-of-life impacts of energy resource development. And, second, they can attempt to ensure that energy-impacted communities are provided planning assistance and adequate and timely planning information. In the following analysis, two categories of policy alternatives responsive to the first objective and one responsive to the second objective are considered:

- Changes in the state and local tax structure;
- Increased impact assistance;
- Improved local planning capabilities.

Specific policy alternatives for each category of alternatives are outlined in Table 9-9. If policymakers elect to change state and local tax structures, they can annex county land to increase the tax base of municipalities, encourage the prepayment of property and sales taxes, provide for state collection and distribution of property taxes on energy facilities, impose severance taxes on the extraction and processing of natural resources, and provide tax incentives that would encourage private developers to take the initiative in mitigating local impacts. Three alternative policies that increase impact assistance are also discussed: special programs for water and sewer facilities in rapid growth areas, distribution of federal land and mineral payments directly to towns, and federal and regional impact assistance for municipalities.

Policymakers can respond to the planning needs of western communities by assuring local officials of accurate and timely impact information prior to energy development. The options facilitating the sharing of information necessary for planning include energy impact planning assistance and impact reporting requirements contained in state siting legislation.

TABLE 9-9: ALTERNATIVE POLICIES FOR GROWTH MANAGEMENT

POLICY OBJECTIVES	CATEGORY OF ALTERNATIVES	SPECIFIC ALTERNATIVES
To provide adequate financing for local services and facilities to assist western towns in accommodating energy-related population growth	Changes in state and local tax structure	Municipal annexation of county land
		Prepayment of property and sales taxes
		State collection and distribution of property taxes on energy facilities
		State severance tax
		Tax credits for private sector impact assistance
	Increased energy impact assistance	Special programs for water and sewer facilities in nonmetropolitan rapid-growth areas
		Distribution of federal land and mineral payments directly to impacted towns
		Federal and regional impact assistance for municipalities
To assure that energy-impacted communities receive adequate and timely information	Improved local planning capabilities	Federal growth management planning assistance
		State siting legislation requiring impact information

The alternatives for responding to the financial and planning needs of western communities are discussed in more detail in the remainder of this section, and implementation strategies are elaborated. The alternatives are then evaluated on the basis of the five criteria outlined in Chapter 3, and comparisons are drawn among alternatives to illustrate the consequences of making each choice.

9.3.2 Description of Alternatives

A. What Are the Alternatives?

The categories of specific alternatives for meeting each of the two general objectives are listed in Table 9-9. The specific alternatives can be categorized according to whether they provide immediate financial impact assistance to communities to mitigate the existing impacts of western energy development or long-term planning assistance to anticipate and avoid the effects of future activity.

(1) Tax Alternatives

Policy alternatives to satisfy the first objective assume that financial impacts will occur and that these can and should be redistributed, either by changing the state and local tax structure or by altering federal impact assistance programs. As mentioned in Section 9.2.1, energy development facilities are often located in rural jurisdictions, whereas workers who operate the plants usually live with their families in nearby towns, which are unable to meet the increased demands of these new residents. Redistribution could take place at the county level, by returning a portion of county property and other tax receipts to communities based on population. Similarly, state redistribution could collect revenues at the county level and return them to the municipal governments where rapid population growth has occurred.

(a) Annexation

Since there are few mechanisms or incentives for distributing county revenues to municipalities, the first specific alternative would facilitate municipal annexation of county lands where energy facilities are located, thus allowing local communities to increase their tax base and extend their zoning and planning powers to energy development sites. Subsequent increases in municipal revenues could then be used to finance higher levels of services.

Many western states have constitutional provisions that allow municipalities to annex county property with the concurrence of the affected residents and the county government. One version of this alternative provides for cooperative, power sharing agreements between a county with a large tax base and cities and towns to participate in financing necessary public facilities. For example, the Wyoming Joint Powers Act permits counties, municipalities, school districts, or special districts to plan, create, finance, and operate jointly in a number of functional areas.[1] Utah has enacted a similar mechanism, the Interlocal Cooperation Act,[2] which allows governmental units to exercise jointly any powers either of them can exercise separately. Whether these alternatives eliminate the disparities in revenue between different jurisdictions will be evaluated in Section 9.3.3, and their applicability to other states in the eight-state study area will be assessed.

(b) Prepayment of Taxes

Even if municipalities and county governments have a sufficiently large tax base from which to draw revenues for financing increased levels of public services and facilities, new demands often arise before energy resource development facilities become operational and begin paying taxes. To solve this problem, the second specific alternative would require the prepayment of property taxes to give local governments "front-end" money to finance higher levels of services, as well as capital improvements. The state could collect the estimated tax obligation that a facility would expect to incur during the construction or operation period and spend the money on local community needs. Then when actual tax assessments are made, energy companies would receive a tax credit for the portion they had prepaid.

(c) State Collection and Distribution of Taxes

The property tax has traditionally been a revenue source primarily for local governments, and no state government in the West derives a major proportion of its revenue from this mechanism.[3] However, the third specific alternative, which calls for changing state and local tax structures, would allow the states to collect and distribute property taxes on energy facilities as a means of equalizing tax revenues among jurisdictions. Since one of the problems identified in Section 9.2.1 was not a shortage of revenue within the state, but rather inequities in the distribution of total property tax revenues among jurisdictions, policymakers seeking to achieve a better use of available revenue could choose this alternative. This alternative is patterned on a Wisconsin plan which provides for the statewide sharing of all property tax revenues from energy plants.[1] A tax rate equal to the statewide average of all state, county, and local taxes could be applied to the value of energy companies' taxable property and the revenues could be distributed to impacted communities.

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[1] Bronder, L.D., N. Carlisle, and M.D. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977, p. 340; see also Sections 9-18.3 through 9-18.20 of the Wyoming Statutes.

[2] Utah Code Ann., § 11-13 (1953).

[3] Bronder, Carlisle, and Savage. Financial Strategies; Stinson, T.F., and S.W. Voelker. Coal Development in the Northern Great Plains: The Impact of Revenues of State and Local Governments, Agricultural Economic Report No. 394. Washington, D.C.: Department of Agriculture, 1978.

(d) Severance Taxes

A fourth specific alternative in this category is for policymakers to adopt a state severance tax on the extraction and processing of natural resources. The severance tax has been defined as "a levy assessed at flat or graduated rate...on the privilege, process, or act of commercially severing or extracting natural resources from soil or water and measured [illegible] the physical amount or the gross or net value of the natural resources produced or sold."[2] The tax can be based either on specific units of production (cents per ton produced) or on the gross value of the production (percent of gross value or proceeds). All of the states in this study except Arizona, South Dakota, and Utah have imposed a severance tax on coal, oil, and gas, and various states also tax electricity generation, mining, and oil shale activities.[3]

(e) Tax Credits

The fifth specific alternative for changing state and local tax structures is to allow energy companies to claim a tax deduction for the value of any impact assistance they provide. This option is designed to increase the amount of private sector impact assistance available to local communities. Although energy developers have provided some impact assistance and in-kind services to municipalities, they have been reluctant to increase their role without some recognition in the form of tax incentives. Companies have also been hesitant to provide impact assistance in connection with their projects because states often place limitations on the allowable costs of business that may be recovered through increases in the rate base. Thus, one version of this policy alternative might broaden the definition of costs that can be passed through to customers by electric utilities.

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[1] Chapter 76, Wisconsin Statutes, 1971.

[2] Bronder, Leonard D. Taxation of Coal Mining: Review with Recommendations. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1976.

[3] Bronder, L.D., N. Carlisle, and M.D. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977.

(2) Impact Assistance Alternatives

The second category of alternatives for providing financial assistance to energy-impacted communities focuses on improvements in and additions to the existing array of federal aid programs. While there are currently a large number of federal programs which could provide impact assistance for local community needs, these are usually subject to competing claims from communities with needs unrelated to energy development. Further, as discussed in Section 9.2.1, the eligibility criteria for existing federal programs favor rapid-growth areas in metropolitan areas.

(a) Special Water and Sewer Programs

The first specific policy alternative in this category would overcome these problems by instituting special water and sewer programs for nonmetropolitan rapid growth areas. Earmarking funds for nonmetropolitan areas would enable policymakers to target the money more directly to energy-impacted areas, rather than to rapid-growth suburban areas.

(b) Federal Land and Mineral Payments

The distribution of federal land and mineral payments directly to towns on the basis of population growth involved the reallocation of existing assistance funds rather than an increase in the total amount of funds available. A portion of these payments currently is distributed to counties and school districts,[1] exacerbating the inequality in revenues between local government jurisdictions discussed in Section 9.1. The payment of funds directly to local communities would free these jurisdictions from dependence on loans which are currently made in anticipation of revenues.[2] These funds could be used to finance a wide range of local needs deriving from the increase in the service population associated with energy development. One proposed variation on this option would allow states to borrow against future mineral royalties to meet front-end costs.[1]

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[1] Public Lands-Local Government Funds Act, Pub. L. 94-565, 90 Stat 2662, 31 U.S.C. 1601 et seq.

[2] Federal Land Policy and Management Act of 1976, Pub. L. 94-579, 90 Stat. 2743, 43 U.S.C. 1701 et seq. See also, Savage, M.D. "An Overview of Strategies for Financing the Mitigation of Socioeconomic Impacts," in Bronder, L.D., N. Carlisle, and M.D. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977, pp. 568-71.

(c) Federal Impact Assistance

The third policy option for changing federal energy impact assistance programs would increase the funds available through EDA and the Title V Regional Commissions,[2] and disburse them directly to local communities. These two agencies have frequently provided grants to communities for water and sewage treatment plants, and some state officials think they could play a larger role (see box, "Regional Commission Impact Assistance"). Although the emphasis of this category of alternatives is on providing financial assistance to impacted communities, the Title V Commissions could also contribute to meeting the second objective by providing planning assistance and information to local communities.

(3) Information Alternatives

Two specific policy proposals have been identified for policymakers who wish to assure that impacted communities have accurate and timely information about energy development.

(a) Federal Planning Assistance

The first specific alternative calls for comprehensive information, planning, and impact assistance at the federal level. One attempt to create such a program is the "Energy Impact Assistance Act of 1978," introduced by Colorado Senator Gary Hart and

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[1] Section 317(c) of the Federal Land Policy and Management Act of 1976 already allows states to borrow against future mineral royalties. However, since the Secretary of the Interior has refused to lend money at the three percent interest rate mandated in the Act, measures have been introduced in both the House of Representatives and the Senate to raise the rate to that at which states now issue tax-exempt municipal bonds (4-1/2 - 5-1/2 percent). See U.S., Congress, House of Representatives, Report 95-211 to accompany H.R. 10787, "Authorizing Appropriations for Activities Carried Out by the Secretary of the Interior through the Bureau of Land Management," May 10, 1978.

[2] Public Works and Economic Development Act of 1965, Pub. L. 89-136, 79 Stat. 552, 42 U.S.C. 3241, 3243, 3245. The area covered by this study includes two regional commissions: Four Corners (Utah, New Mexico, Arizona, Colorado), created in 1965; and Old West (North Dakota, South Dakota, Nebraska, Montana, and Wyoming), created in 1972. See also Derthick, Martha. Between State and Nation: Regional Organizations of the United States. Washington, D.C.: Brookings Institution, 1974.

West Virginia Senator Jennings Randolph.[1] This bill is modeled on the Coastal Zone Management Act (CZMA)[2] and would "provide financial and technical assistance to state, local governments, and Indian tribes suffering economic impact as a result of energy development activities."[3]

The bill provides for establishing impact assistance teams composed of federal, state, and local officials. These teams would assess the impacts of energy development on specified areas and identify available sources of assistance. The impact assistance team would also prepare a mitigation plan based on the results of its preliminary assessment. This plan would identify means for mitigating immediate impacts of energy development and procedures for establishing a continuing planning capability.

REGIONAL COMMISSION IMPACT ASSISTANCE

At about the same time as the introduction of the Inland Energy Impact Assistance Bill, Governor Thomas L. Judge of Montana proposed a somewhat different solution. In a meeting with President Carter, Judge proposed increasing the funds available to the Old West and Four Corners Regional Commissions to $20 million annually. In addition, he proposed that the Commissions be authorized to provide 100 percent funding for energy impact projects, 20 percent more than is presently authorized. The legislative requirements would be simpler than in the case of the Hart Bill, which would set up a new bureaucracy modeled on the Office of Coastal Zone Management. Judge's proposal gives strong support for the Title V Regional Commissions as regional institutions in which the states and the federal government are both active.

--Old West Regional Commission Bulletin, Vol. 4 (July 15, 1977), p. 1.

(b) Siting Information

The second specific policy alternative for providing accurate and timely energy development information relies on the states to adopt facility siting legislation with impact reporting requirements. Local areas that have not previously experienced energy development or for which new types of energy facilities are planned have a particular need to obtain a description of the impacts that can be expected. At a minimum, the legislation would require reporting of information on the needed construction and operating work force, water use, land use, land needed for mining and waste disposal, and air and water residuals. Although the kind of comprehensive facility siting legislation that this option would require is not yet common in the West, the Wyoming Industrial Development Information and Siting Act of 1975 is an example of the mechanisms policymakers could adopt.[1] The WISA conditions the approval of siting permits for major energy and industrial facilities on the mitigation of socioeconomic impacts. As a result of this stipulation, Basin Electric Power Cooperative agreed to provide major impact assistance to Wheatland, Wyoming, near the site of its power plant.[2]

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[1] The 1978 Act is an amended version of Senate Bill 1293, Inland Energy Development Impact Assistance Act of 1977, introduced in May 1977 by Senator Hart.

[2] Coastal Zone Management Act of 1972, as amended, 1976, Pub. L. 94-370, 90 Stat. 1013, 16 U.S.C. § 1013.

[3] "Inland Energy Development Impact Assistance Act of 1977--S. 1493." Congressional Record, Vol. 124 (May 10, 1978), Section 2.

B. How Can the Alternatives Be Implemented?

Implementation strategies for each of the three general categories of alternatives described above are summarized in Table 9-10. This table indicates where primary responsibility for implementation would be located, whether incentives or sanctions would be required, and identifies some of the constraints associated with each specific alternative. Each of these entries will be addressed in more detail as alternatives are evaluated in the following section (9.3.3); they are set forth here to facilitate a general comparison of alternatives.

With regard to roles and responsibilities, each specific implementation strategy provides for a public role and/or responsibility. This is perhaps most understandable with respect to changes in existing federal energy impact assistance programs where the federal government already plays a major role. The major impetus for federal involvement has been the feeling that the federal government, as the major landowner, should also bear a portion of the cost of mitigating the impacts caused by energy development on federal land. The regional demand for a strong federal role is also tied to the residents' perception that much energy development in this area will occur to meet national energy objectives and therefore the federal government has a responsibility to mitigate some of the impacts of this development. The U.S. Congress has acknowledged some federal responsibility

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[1] Wyoming Statutes 35-502 et seq. (Cumulated Supplement 1975).

[2] Wyoming Industrial Siting Administration, Docket No. WISA-75-3. See also Valeu, R.L. "Financial and Fiscal Aspects of Monitoring and Mitigation." Paper presented at the Symposium on State-of-the-Art Survey of Socioeconomic Impacts Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977.

TABLE 9-10: IMPLEMENTATION STRATEGIES FOR GROWTH MANAGEMENT

ALTERNATIVE	IMPLEMENTATION STRATEGY	CONSTRAINT
Municipal annexation of county land	Extend municipal jurisdiction to rural areas through joint powers acts or special districts	Rural residents object to higher taxes; county governments protective of sovereignty
Prepayment of sales and property taxes	Enact state law to require prepayment of taxes; remove disincentives for prepayment in federal tax law	Federal tax law contains disincentive; firm takes risk if project cancelled
State collection and distribution of property taxes on energy facilities	Enact state law to apply statewide average tax rate in lieu of all other state and local taxes	Jurisdictions with higher revenues oppose reallocation
State severance tax	Enact state severance tax applied to the unit or gross value of production	Energy-consuming states contest the tax as inequitable
Stimulate private sector impact assistance	Amend federal and/or state tax codes to provide a tax deduction for private sector assistance Change state rate-setting formula to allow utilities to pass assistance costs to consumers	Tax law contains disincentive State utility commissions allow only certain costs to be included in rate base
Special water and sewer programs in nonmetropolitan rapid-growth areas	Enact federal program to provide water and sewage treatment facilities for rapid-growth communities in rural areas	Current programs favor rapid-growth suburbs
Distribution of federal land and mineral payments directly to impacted towns	Amend distribution procedures to allow impacted towns to receive land and mineral payments directly	States, counties, and school districts protective of their control over these funds
Federal and regional impact assistance for municipalities	Provide specific appropriation for federal energy impact assistance Increase funding for regional commissions	States would demand some control; likely opposition from nonwestern regions
Federal growth management planning assistance	Enact a federal impact assistance bill to provide technical assistance to rapid-growth communities	Extensive planning requirements
State siting legislation requiring impact information	Enact state siting law containing requirements that developers provide impact information to communities	No effect on existing impacts

by passing the Public Lands-Local Government Funds Act or "In Lieu of Tax Payment" Act, as well as the BLM Organic Act.[1]

Alternatives involving changes in state and local tax structures require a predominantly state or local role. If one of these alternatives is chosen, state and local action will be required primarily to establish mechanisms that would provide more financial impact assistance to local communities. These mechanisms include changes in the legal requirements for annexation, as well as amendments to the state and federal tax codes to provide incentives for early payment of taxes and for private sector initiatives in impact assistance.

The final category of alternatives includes two policy options that require significant roles and responsibilities for federal and state governments and the private sector. Growth management planning assistance would be provided by the federal government, but it also requires a positive response from the states, which must adopt growth management plans and set priorities for future development. On the other hand, the initiative for including impact information requirements in siting legislation would rest with the individual states. Private energy developers also have a role because they would be required to show that efforts had been made to mitigate the impacts of development before receiving a siting permit.

The policy alternatives considered for growth management vary somewhat in their implementability. Proposals that would change state or local tax structures are most difficult to have accepted, since they reallocate existing tax revenues. The municipal annexation of county land is designed to enable energy-impacted communities to include nearby energy facilities within their jurisdiction so energy developers can be taxed at the same level as municipal residents; however, this option has generally proved difficult to implement, since most states require the consent of the county and of the residents on the land proposed for annexation. The county government is likely to oppose such measures because it stands to lose considerable tax revenue, and citizens fear they will pay higher taxes under municipal jurisdiction without benefiting from municipal services. Therefore, annexation appears to be a workable strategy only if policymakers can modify existing annexation procedures or offer substantial inducements to county citizens to agree to be annexed.

The prepayment of sales and property taxes would shift the time at which tax revenues become available to local officials without increasing the total money available. It would require that the state legislature adopt a change in collection procedures similar to Utah's 1975 Resource Development Act, under which energy developers may prepay state sales tax obligations they would expect to incur during construction or operation.[1] The money is then spent on state-related improvements in the impacted areas. This option might also allow direct disbursement to local governments for spending on impact-related problems which they have given high priority. However, there are several potential problems which make this proposal unattractive unless incentives or inducements are adopted. Tax prepayment is costly to companies because they pay the taxes earlier than they are owed and the Internal Revenue Service prohibits the deduction of the full amount of the taxes in the year in which they are prepaid.[2]

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[1] Public Lands-Local Government Funds Act, Pub. L. 94-565, 90 Stat. 2662, 31 U.S.C. 1601 et seq.; Federal Land Policy and Management Act of 1976, Pub. L. 94-579, 90 Stat. 2743, 43 U.S.C. 1701 et seq.

The policy alternative which would have the state collect and distribute property taxes on energy facilities provides another method of overcoming inequities in available revenue between jurisdictions. Taxing powers currently are shared among state, county, and local jurisdictions and legislative action might be required to set a statewide tax rate. The precedent for this proposal is a plan for statewide sharing of property tax revenues from energy plants adopted by Wisconsin in 1971.[3] There is likely to be considerable opposition to the implementation of this alternative for two reasons: local governments fear loss of control over the taxing power; and jurisdictions with higher revenue collections do not want to lose tax monies to other areas of the state. The final tax structure alternative, tax credits for private sector initiative in providing impact assistance, would require a change in the states' tax codes, and would likely arouse a good deal of opposition if it were seen as a special favor to business. It also runs counter to the philosophy that the full costs of energy development should be internalized (i.e., be borne by the developers as a development cost).

The category of alternatives that focuses on changes in energy impact assistance programs involves the least change from existing policies. The major intent of these options is to aim current impact programs more directly at energy-related population growth problems. However, there is likely to be moderate to strong opposition by urban communities if special water and sewer programs are established for nonmetropolitan rapid-growth areas, and state governments will likely be reluctant to give up control over federal land and mineral revenues. Implementation will also be influenced by the ratio of grants to loans in specific programs, since local officials tend to prefer grants which do not have to be paid back. Thus, federal and regional impact assistance to municipalities will probably be the easiest option to implement, since it could be accomplished by expanding appropriations for EDA, general revenue sharing, or the Title V Regional commissions. If direct municipal assistance were to be provided through general revenue sharing reallocations, states might oppose it.[1]

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[1] U.S., Department of Housing and Urban Development, Office of Community Planning and Development. Rapid Growth from Energy Projects: Ideas for State and Local Action. Washington, D.C.: Government Printing Office, 1976, pp. 33-34.

[2] U.S., Department of Energy, Energy Impact Assistance Steering Group. Report to the President on Energy Impact Assistance Draft Report. Washington, D.C.: Department of Energy, 1977, p. 99.

[3] HUD. Rapid Growth from Energy Projects, p. 33.

The final set of alternatives represents the most significant departure from existing policies. The two proposals--for federal growth management planning assistance and state siting legislation with impact requirements--both seek to increase the information available to officials in local communities. Both could be implemented fairly easily although there is still some philosophical reluctance on the part of many citizens to embrace the idea of widespread public planning. Incentives for federal growth management planning assistance include technical assistance to states and communities to develop growth management plans. The requirement that a growth management plan be adopted could also act as an incentive.

9.3.3 Evaluation of Alternatives

A. Evaluation Criteria

The assessment and comparison of alternative policies and implementation strategies is based on five criteria that have been developed by the research team: effectiveness, efficiency, equity, flexibility, and implementability. Table 9-11 illustrates how each criterion is defined in terms of the substance of growth management problems and issues. This description is based on the policy context of growth management issues in the West (9.2.2) and derives from the policy objectives defined above (9.3.1). Only the two categories of alternatives to meet the first objective are evaluated in detail in this chapter.

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[1] The Inland Energy Development Impact Assistance Act of 1977, introduced by Senator Gary Hart of Colorado as S. 1493 in May 1977 would provide loans to states for front-end investment in facilities and services, together with repayment assistance of the possibility of forgiveness if development does not materialize. This proposal was revised and reintroduced by Senator Hart in May 1978 with Senator Jennings Randolph of West Virginia as coponsor. The new version of the bill would coordinate all federal impact assistance programs and create an Office of Emergency Impact Assistance within the Commerce Department. Federal, state, and local officials would serve as members of "assessment teams" to help appraise problems in specific communities. "Inland Energy Development Assistance Act of 1977, S. 1493." Congressional Record, Vol. 124 (May 10, 1978).

No single alternative is likely to rank high on every criterion. Therefore policymakers have to make trade-offs in their choices of methods for avoiding or mitigating negative impacts. The purpose of this section is to discuss some of the implications and consequences of taking a particular policy action.

As applied to the issue of growth management, the five criteria in Table 9-11 address two general concerns. The first concern is with the amount of new impact and planning assistance that can be made available to impacted communities in the western states. Questions considered as part of this concern include: how much assistance can be provided through existing impact aid programs? how much assistance can be provided by new programs? what are the costs, risks, and benefits of different alternative methods of providing assistance? what groups will pay for the increased assistance? The second general concern is with the process for either avoiding or mitigating growth management problems. The process will be evaluated primarily in terms of whether specific options can be implemented and whether they are adaptable to changing demands for local services and facilities. In addition, relationships among various levels of government, as well as between the public and private sectors are considered. (The discussion in Section 9.1 dealt with jurisdictional conflicts between the federal government and the states and localities, as well as between states and municipalities, counties and municipalities, and between different counties.) A consequence of failing to implement policies which do a better job of allocating revenues among jurisdictions is likely to be a continuing shortage of financial and planning assistance when and where it is most needed to avoid or mitigate the impacts of energy development in the West.

B. Evaluation of Alternatives for Changing State and Local Tax Structures

Five specific alternatives for changing state and local tax structures are evaluated and compared in this section:

- Municipal annexation of county land;
- Prepayment of sales and property taxes by industry;
- State collection and distribution of property taxes on energy facilities;

TABLE 9-11: EVALUATION CRITERIA APPLIED TO GROWTH MANAGEMENT

CRITERIA	AS APPLIED TO GROWTH MANAGEMENT	MEASURES
Effectiveness Are the objectives achieved?	Does alternative increase availability of funds?	Quantitative: Dollar value of increased assistance Timing of assistance Distribution of assistance
Efficiency What are the costs, risks, and benefits?	What are the economic costs? What are the risks of loss or failure? What are the benefits to western residents?	Quantitative: Economic costs and benefits Risk of loss or failure Social costs and benefits Environmental costs and benefits
Equity How are the costs, risks, and benefits distributed?	Does this add to consumers' energy costs? Who will pay: taxpayers? industry? western residents? landowners?	Quantitative: Ratio of federal aid to federal taxes collected Energy costs as a percentage of total income Qualitative: Distribution of costs, risks, and benefits among taxpayers, industry, residents, landowners
Flexibility How flexible is it?	Are local differences in impacts considered? Are existing planning and other mechanisms utilized or are they replaced? Are firms required to comply with procedures or are actions mandated?	Qualitative: Adaptability (low, medium, or high) Degree to which adjustments to local differences are possible
Implementability How can it be adopted?	Is federal subsidy kept to a minimum? Are both public and private interests involved? Are industry initiatives included? Are landowners' interests considered?	Qualitative: Assessment of acceptability Ease of administration

- State severance taxes;
- Tax credits for private sector impact assistance.

As these specific alternatives suggest, changes in tax structure could be made at both the state and local levels. (Incentives, inducements, and sanctions for achieving these changes were described in Section 9.2.3, together with appropriate institutional arrangements.) Suggested implementation strategies include:

- Changing legal requirements for annexation;
- Enacting state laws allowing prepayment of taxes and removing federal tax disincentives for doing so;
- Changing the state tax code to enable the collection of a single state tax on energy facilities;
- Enacting a tax on extraction and processing of natural resources;
- Changing state tax codes to allow deductions for private sector impact assistance.

The success of each policy alternative will be primarily a function of the particular implementation strategy that is specified. Each of the implementation strategies requires some action by state or local governments. The last strategy is designed to encourage a larger role for the private sector. Other options not discussed in this section might stimulate a larger private sector role in providing impact assistance. It should also be noted that the consequences of each alternative are largely dependent on the underlying assumptions of the various implementation strategies that might be pursued.

(1) How Much Impact Assistance Could Be Provided?

The effectiveness of the five strategies in this section depends both on the tax base available to various levels of government and on the rate at which taxes are assessed. For example, the additional taxes that can be collected on new property annexed by a municipality may or may not be adequate to finance the increased levels of services and new capital facilities needed.[1] Taxes are more likely to be adequate to meet increased demands for services and facilities when the new energy plants are capital-intensive. In theory, municipal annexation of county lands could be an effective option for providing revenues to cities and towns. However, county governments to date have not been willing to relinquish their control over taxing authority on county property; therefore, it is difficult to determine the tax revenues that could be made available for impact assistance if this specific alternative were implemented.

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[1] Bronder, L.D., N. Carlisle, and M.D. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts in Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977, p. 23.

The second specific alternative, the prepayment of sales and property taxes, does not increase the total amount of money available for impact assistance; however, it does make funds available earlier and thus can overcome or mitigate the "lead-time" problem. If the prepaid taxes are distributed to impacted cities and towns, rather than counties, the prepayment alternative can also be a fairly effective strategy for increasing the amount of revenue available to cities and towns for impact assistance.

State collection and distribution of property taxes ranks as a highly effective alternative because it allows policymakers to draw on the entire state as a revenue base, with the power to reallocate tax monies statewide, and to distribute these monies on the basis of needs. This strategy is also particularly effective for alleviating the problem of jurisdictional mismatches described in Section 9.2, i.e., by ensuring that the jurisdiction bearing the costs receives the benefits.

The effectiveness of state severance taxes in meeting state impact needs will depend both upon the rate of taxation and the level of mining and processing activity within a particular state. Table 9-12 compares the current severance tax collections of the six states in the study area that have severance taxes. This mechanism appears to be very effective for raising impact assistance funds, especially in New Mexico, Wyoming, and Montana. However the effectiveness of the severance tax as a policy alternative to provide impact assistance funds also depends upon the manner in which revenues are distributed to impacted areas (see Table 9-1). Distributional questions about this alternative are discussed in Section 9.3.3(C).

The specific alternative of granting tax deductions for impact assistance provided by industry can also be effective, especially on a site-specific basis. Energy companies have played a role in setting up and maintaining numerous services and facilities in energy-impacted communities. At a minimum, these usually include streets, water and sewer distribution or collection networks, and parks. For example, Basin Electric Power Cooperative has provided about 1,900 units of housing together with

TABLE 9-12: STATE SEVERANCE TAX COLLECTIONS, 1974-1976
(millions of dollars)

STATE	YEAR		
	1974	1975	1976
Colorado	$ 1	$ 2	$ 4
Montana	10	15	31
New Mexico	44	72	87
North Dakota	4	7	13
Utah	5	6	12
Wyoming	5	18	41

SOURCE: U.S., Department of Energy, Energy Impact Assistance Steering Group. Report to the President on Energy Impact Assistance, Draft Report. Washington, D.C.: U.S., Department of Energy, 1977, p. 107.

other services in connection with its power plant near Wheatland, Wyoming,[1] and similar assistance could be expected in other areas.

In summary, the following alternatives can effectively provide additional revenue to cities and towns impacted by energy development: prepayment of sales and property taxes; statewide collection and distribution of property taxes on energy facilities; state severance taxes; and tax deductions for private sector impact assistance. Increasing the municipal tax base through annexation of county land is a somewhat less effective alternative because of uncertainties about the correspondence between additional tax revenues from the newly-annexed property and the needs of impacted communities.

(2) What Will these Alternatives Cost?

The economic costs and benefits of changes in the tax structure appear to be minimal, since these alternatives generally call for a reallocation of existing tax revenues, rather than an appropriation of new funds. The highest increase in economic costs will likely result if companies are required to prepay sales and property taxes. The increased costs are incurred as interest payments by industry when tax assessments are paid before they are normally due. Additional economic costs are also associated with state severance taxes and are proportional to the rate of taxation. At the present time, for example, the economic costs to industry of a severance tax on coal would be highest in Montana (30 percent).

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[1] Wyoming Industrial Siting Administration, Docket No. WISA-75-3. See also Valeu, R.V. "Financial Aspects of Monitoring and Mitigation." Paper presented at the Symposium on State-of-the-Art Survey of Socioeconomic Impact Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977.

The social benefits derived from these policy options could be quite high. Increases in impact assistance can be used to improve the social infrastructure in impacted communities and thereby improve the quality of life. If the impacted community is able to develop a large enough tax base, it will be able to provide the services and facilities demanded by both new and long-time residents, thus reducing the costs of dealing with boom-related social problems such as crime, drunkenness, delinquency, mental illness, and so forth. Water and sewage treatment plants are among the public facilities that will benefit from increased funds made available to impacted cities and towns, and the resulting expansion of plants and equipment could yield identifiable environmental benefits when fewer and/or more adequately treated effluents are released into rivers and streams.

(3) Who Bears the Costs, Risks, and Benefits of Changes in the Tax Structure?

Each alternative that secures a change in the tax structure is based on the assumption that the costs and benefits of energy development will be widely distributed. If an energy facility located near an impacted town is annexed, taxes on the facility can be used to finance the increased services its workers demand. The prepayment of property and sales taxes shifts the finance costs for "front-end" needs from impacted communities to energy developers. Statewide collection and distribution of taxes on energy facilities ensures that the costs and benefits of energy development are spread across the entire state, rather than being absorbed by a single community or local jurisdiction. A severance tax on energy resources is passed through to customers; therefore, residents outside the region where the energy is produced share in the costs of impact assistance when they purchase power generated from the coal, oil, gas, or uranium upon which the tax has been imposed.

Of all the alternatives discussed in this section, the severance tax raises the most far-reaching questions about equity. Current tax rates in the eight-state study area range from about 2 percent for oil and gas production in some states to a high of

30 percent on coal production in Montana.[1] The wide variation in the tax rate suggests there are different opinions about what is a "fair" or allowable rate. One report argues that states in the Northern Great Plains use the severance tax as an opportunity "to shift a substantial part of their state tax burden onto coal consumers in other states and coal-producing companies."[2] Montana's severance tax on coal, which is the highest in the U.S., is currently being challenged by Wisconsin Power and Light Company on the basis that it is excessive and a burden on commerce.[3] However, officials in Montana describe another side of the problem. Jim Nybo, a former official of the Montana Energy Advisory Council, defends the state's 30 percent severance tax on two grounds:

> It does two main things. It sets up a structure where we can let coal development pay for the adverse social and economic effects that are imposed on our state because of the development. Second, it sets aside some of the revenues from the one-shot exploitation of coal and invests it in the future.[4]

Policymakers will have to consider the equity of various policy alternatives in this category in terms of the severity and duration of impacts, the taxing and financing structure of local governments which would allow them to meet local needs with local resources, and the national demand for energy. However, the equity of a particular policy alternative is ultimately a matter of perception. Since perceptions of equity are likely to differ, the successful implementation of any alternative depends upon the ability of policymakers to accommodate different perceptions of equity or offer incentives, inducements, and sanctions to various stakeholders to get them to accept some level of inequity.

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[1] Bronder, L.D., N. Carlisle, and M.D. Savage. Financial Strategies for Alleviation of Socioeconomic Impacts of Seven Western States. Denver, Colo.: Western Governors' Regional Energy Policy Office, 1977. See also Table 9-1.

[2] Nehring, Richard, and Benjamin Zycher. Coal Development and Government Regulation in the Northern Great Plains: A Preliminary Report, R-1981-NSF/RC. Santa Monica, Calif.: The Rand Corporation, 1976.

[3] "The Fuels Outlook." Electrical World, Vol. 189 (March 1, 1978), p. 49.

[4] Schneider, Richard, and John S. Gilmore. Report of the Denver Workshop on State-Local-Federal Relationships in Socioeconomic Impact Assessment. Denver, Colo.: University of Denver, Denver Research Institute, n.d.

(4) How Flexible Are the Alternatives?

The policy alternatives for changing state and local tax structures to increase the amount of revenue provided to impacted areas can generally deal with growth management problems and issues in a flexible manner. Municipal annexation of county land can be applied in any local jurisdiction in the West to broaden the tax base. This option, as well as the prepayment of sales and property taxes and the granting of tax credits for private sector impact assistance, is applied on a site-specific basis; thus, the design of these policies inherently assures that local differences will be considered. The remaining two alternatives, proposing state collection and distribution of property taxes on energy facilities, and the imposition of a severance tax, would be applied uniformly on a statewide basis. Nevertheless, these two specific alternatives still achieve a high degree of flexibility by distributing funds to various levels of government and local communities to mitigate specific impacts. An additional degree of flexibility is achieved because tax revenues depend directly on the valuation of a facility or its output; increased energy development will yield additional revenue, although the revenues may not accrue until the operations phase begins.

Some specific policy alternatives in this category involve trade-offs between flexibility and equity. While elimination of jurisdictional inequities in funding seems to meet the criterion of equity, this is achieved at the expense of uniformity in tax structures among the different jurisdictions. For example, municipal annexation equalizes the tax burden between urban residents and the rural county in which an energy facility is located, but it also affects ranchers who may have demands for government services that are different from those of city residents. The state collection and distribution of property taxes preserves both equity and flexibility because it creates a common pool of revenue and then distributes it on the basis of local needs.

(5) Can These Alternatives Be Implemented?

The variety of stakeholders involved makes the implementation of the policy alternatives for this particular category quite difficult. Municipal annexation of county lands has almost invariably encountered opposition from the county government, which sees itself losing sovereignty, and from affected residents who fear they will be required to pay higher municipal taxes without receiving any municipal services. Because of this opposition, many states have incorporated in their constitutions the principle that no land may be shifted between jurisdictions, except with the consent of the government jurisdiction in which the land is currently located and the affected landowners. In Wyoming, for example, landowners must give permission for annexation when the valuation of the property to be annexed exceeds $100,000. Given this constraint, it may be difficult for policymakers to change existing annexation procedures unless they are able to persuade property owners to support annexation, perhaps by offering services which they now lack.

Prepayment of sales and property taxes is difficult to implement at the state level without concomitant federal action. As noted earlier, private energy developers have little incentive to pay taxes before they would normally be due because the Internal Revenue Service currently does not allow companies to take the full amount of the deduction for the year in which taxes were prepaid, and companies will be reluctant to make further prepayment even when required by law, unless this tax regulation is changed.

State collection and distribution of property taxes on energy facilities would require changes in long-established taxation priorities and could be viewed by local governments as an intrusion on their power and authority. They would probably have to be assured that they will receive equivalent aid from the state in return for relinquishing their prerogative to tax energy facilities.

Tax credits for private sector impact assistance are also likely to encounter implementation difficulties since they are viewed by some as special favors or "tax breaks" for business. It might also be difficult to arrive at an acceptable value for some services, such as in-kind assistance, furnished by energy developers.

In comparison to the first four alternatives, the implementation of state severance taxes on energy resources should pose few problems, since each of the six states in the study area within which large-scale resource extraction and processing will occur already has adopted some form of severance tax. Implementation concerns would arise primarily from state attempts to increase the tax rate.

The evaluation of the set of alternatives proposing changes in state and local tax structures is summarized in Table 9-13. This summary is intended to organize information about specific policy alternatives in order to inform policymakers about possible trade-offs among policy alternatives for providing adequate revenue to energy-impacted communities. In Section 9.4, this category of alternatives will be compared with another category that would increase communities' revenues by raising the level of federal energy impact assistance.

C. Evaluation of Changes in Impact Assistance Programs

This section contains an evaluation and comparison of three specific policy alternatives to accomplish the general objective of providing more revenue to impacted towns:

TABLE 9-13: A SUMMARY EVALUATION OF THE TAX STRUCTURE CATEGORY

CRITERIA	MEASURES	FINDINGS
Effectiveness How effective will changes in tax structure be in providing adequate revenue for local services and facilities?	Dollar value of assistance compared to needs	Amount of assistance depends on tax base and rate. Taxes likely to correspond with local needs when facilities are capital-intensive.
	Timing of assistance	Prepayment of sales and property taxes can overcome or mitigate the lead-time problem.
	Distribution of assistance	Statewide collection and distribution of property taxes on energy facilities and incentives for private sector impact assistance can effectively distribute impact assistance to the areas needing assistance.
Efficiency What will be the costs, risks, and benefits of changes in tax structure?	Economic costs and benefits	Few new costs because existing tax revenues reallocated. Higher costs for developers if taxes prepaid. Severance taxes increase energy development costs.
	Risk of loss or failure	Risk of construction slowdowns reduced. Worker productivity increased. Firms take risk if taxes prepaid and project cancelled.
	Social costs and benefits	Provision of adequate services should assure higher quality of life and reduce social costs by preventing or minimizing social problems.
	Environmental costs and benefits	Availability of funds for water and sewage treatment facilities should reduce environmental costs.
Equity How will these costs, risks, and benefits be distributed?	Costs	Alternatives all attempt to distribute costs more widely and equitably. Prepayment of taxes and severance taxes will result in more economic costs to industry than for other stakeholders.

TABLE 9-13: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity (Continued)	Risks	Risk of development being cancelled is shifted to the private sector with the prepayment of property and sales taxes. Other alternatives distribute risks across the states or among regions.
	Benefits	All alternatives should result in benefits for impacted communities in the form of adequate funds for needed services.
Flexibility Is the alternative sufficiently flexible to be applicable under a variety of conditions and over time?	Adaptability	Municipal annexation, prepayment of taxes, and tax incentives for industry assistance are site-specific and tailored to local impacts. Severance taxes and property taxes collected statewide are distributed to local communities as the need arises.
	Adjustability	Tax on valuation makes it possible for tax revenues to increase with energy development activity. Tax structure change alternatives are relatively interchangeable to accommodate revenue needs and tax structure of particular impacted areas.
Implementability How difficult will it be to implement the alternative?	Acceptability	Municipal annexation requires landowner and county approval. Counties oppose annexation because of loss of sovereignty. Landowners uncertain about relationship between taxes and local services. States oppose statewide collection/distribution of taxes because they lose control. Alternatives all have problems of acceptability because they reallocate revenues.
	Ease of administration	All alternatives will be difficult to administer because they will require careful coordination between different levels of government and between public and private sectors.

- Special water and sewer grant programs for rapid-growth areas;

- Distribution of land and mineral payments directly to energy-impacted cities and towns;

- Increases in federal impact assistance directly to municipalities or through the Title V Regional Commissions.

In contrast to the specific alternatives in the previous section, alternatives to change existing impact assistance programs would be implemented at the federal level with a variety of incentives, inducements, sanctions, and institutional arrangements. For this category, the following general implementation strategies are considered:

- Changes in eligibility criteria for water and sewer grants to focus such assistance specifically on rapid-growth programs and increase the available funds;

- Amendment of distribution procedures for federal land and mineral payments in the relevant laws;[1]

- Increase funding for regional commissions and EDA change revenue sharing criteria to give more assistance to impacted communities.

The achievement of this objective will depend upon the particular strategy or combination of strategies selected by policymakers. Since each of the strategies presented here involves a federal program it is assumed that the federal government will have the primary implementation role. However, the presentation of these specific implementation strategies is not meant to preclude the consideration of others or the adoption of alternate assumptions about strategies that might be useful.

(1) How Much Impact Assistance Would these Alternatives Provide?

The three specific alternatives for achieving the general policy objective of changing federal impact assistance programs can be quite effective in guaranteeing adequate revenues for energy-impacted towns in the West. These choices do not depend on state or local tax bases, but rather on federal appropriation. The increased federal assistance that can be made available specifically for energy impacts out of existing and new federal sources could exceed $150 million annually if all three policies are implemented.[1]

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[1] Public Lands-Local Government Funds Act, Pub. L., 94-506, 90 Stat. 2662, 31 U.S.C. 1601 *et seq*.; Federal Land Policy and Management Act of 1976, Pub. L. 94-579, 90 Stat. 2743, 43 U.S.C. 1701 *et seq*.

Special water and sewer programs could meet the water and sewage treatment needs of rapid-growth communities by adopting criteria that allocated funds specifically on the basis of population increase. As discussed in Section 9.2.1, over one-half of the towns impacted by energy development in the West lack either a water or a sewer system or are at the capacity of their existing system. A program of special water and sewer grants for rapid-growth communities could meet these needs if the construction grant allotments to western states were increased significantly above the total which they now receive.

Dispensing land and mineral payments directly to the energy-impacted cities and towns would also be effective in meeting the needs of those communities. Since these funds currently are handled by the states, energy-impacted communities must compete with other towns not affected by energy development for a share of the revenue, and when the needs of impacted communities are compared with other state priorities energy impact assistance is often not sufficient to meet community needs.

(2) What Will these Alternatives Cost?

As mentioned above, the costs of increased impact assistance could exceed $150 million per year. This cost would be offset by social benefits deriving from the improved level of services and facilities, and other social and cultural amenities would increase residents' satisfaction with the quality of life. This, in turn, could increase worker productivity by 25-40 percent and reduce labor turnover and construction delays.[2] Since labor turnover, construction delays, and lowered productivity significantly increase the total costs of an energy facility,[3] increases in federal assistance programs generally would yield economic as well as social benefits.

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[1] The minimum figure of $150 million annually reflects the Carter Administration proposal for impact assistance to energy-impacted communities. The addition of loan guarantee programs and other assistance allocated through general revenue sharing or the Economic Development Administration would increase this total substantially. U.S., Office of the White House Press Secretary. "Fact Sheet: Energy Impact Assistance Program." Press release, May 4, 1978.

[2] U.S., Department of Energy, Energy Impact Assistance Steering Group. Report to the President on Energy Impact Assistance, Draft Report. Washington, D.C.: Department of Energy, 1977, p. 34.

[3] *Ibid.*, p. 32

Finally, special water and sewer grant programs for rapid-growth areas would yield substantial environmental benefits in terms of cleaner lakes and streams and purer water supplies for energy development communities. Overall, this category of alternatives is highly efficient in responding to the needs of energy-impacted communities in the West.

(3) Who Bears the Costs, Risks, and Benefits of Increases in Impact Assistance?

Although no strategy to increase federal energy impact assistance is completely equitable, the three strategies to achieve this alternative compare favorably. The equity of special water and sewer grant programs will depend on the particular implementation strategy adopted. If water and sewer grants are provided to all rapid-growth areas, the existing trend of water and sewer grants primarily to fast-growing metropolitan suburbs would continue. On the other hand, if growth criteria are defined to target assistance to energy development communities outside the metropolitan areas, impact problems could be mitigated.

Distribution of land and mineral payments directly to municipalities would by-pass the states, causing them to object to the new policy as inequitable. The increase of federal and regional impact assistance is the most equitable of the three policy options, since it involves several levels of government and is most likely to distribute the costs of energy impacts to consumers outside the West.

(4) How Flexible Are the Alternatives?

Federal and regional impact assistance is a flexible option since the regional commissions and the EDA are able to accommodate a wide variety of administrative options for impact assistance and deal with a broad range of impact needs. The amount of assistance can be increased or decreased among various states under this option, depending on specific community needs.

In comparison, the specific alternative to distribute land and mineral payments directly to towns is somewhat less flexible, since the total allocation of funds to each state remains the same. Thus, the federal government cannot shift impact assistance priorities among states under this option. The functional specificity of special water and sewer grants makes them the least flexible of the three options.

(5) Can these Alternatives Be Implemented?

Special programs to provide water and sewer grants to rapid-growth areas will likely be the most difficult specific policy alternative to implement. However, this will depend on the particular strategy that is employed. If eligibility criteria restrict special grants to nonmetropolitan areas, stakeholders such as governments of rapid-growth metropolitan suburbs who now receive the majority of such grants are likely to make strenuous objections. This constraint on implementation can be reduced or eliminated by making grants available in metropolitan areas as well, but that may defeat the purpose of the option as an energy impact assistance alternative.

The distribution of land and mineral payments to impacted municipalities will be opposed by the states, counties, and school districts that now control those funds. Thus, there will be significant constraints on the implementation of this specific alternative. Federal or regional impact assistance implementation will be problematic if the Title V regional commissions are used to distribute aid, since commissions for the nonwestern states will likely expect to receive comparable increases in funding for their programs.

Table 9-14 summarizes the preceding evaluation of the category of alternatives for increasing federal energy assistance to impacted municipalities in the West. This summary attempts to show policymakers the mix of costs and benefits involved in choosing among various alternatives. Officials have access to several combinations of policies and implementation strategies that will increase impact assistance. In section 9.4 this category of alternatives is compared with another set of alternatives that proposes changes in state and local tax structures.

9.4 SUMMARY AND COMPARISON OF GROWTH MANAGEMENT ALTERNATIVES

Communities in the West impacted by nearby energy development activity will experience severe shortages of local facilities and services in the early stages of the development. This chapter identified and described a number of alternatives and implementation strategies to alleviate the problems caused by rapid growth. These alternatives and strategies are designed to achieve one of two major objectives: to meet the immediate needs of impacted communities for adequate financial assistance to provide needed local services and facilities, and to assure that planning assistance and adequate and timely planning information are provided to impacted communities. Alternatives and strategies addressing the first objective were the principal focus of attention in this chapter, and are the subject of this summary and comparison.

Two categories of alternatives for achieving the objective of providing timely financial assistance were analyzed: changes in the tax structure and increases in impact assistance. Table 9-15 summarizes the comparison and evaluation of these two categories and identifies the trade-offs inherent in making specific policy choices.

TABLE 9-14: A SUMMARY EVALUATION OF THE IMPACT ASSISTANCE ALTERNATIVES

CRITERIA	MEASURES	FINDINGS
Effectiveness How effective will changes in assistance programs be in providing adequate revenue for local services and facilities?	Dollar value of assistance compared to needs	A minimum of $150 million increase in federal impact assistance. New water and sewer facilities could be provided for all impacted towns now lacking plants or exceeding capacity of existing plants.
	Distribution of assistance	All three alternatives would improve distribution of impact assistance funds by dispensing funds directly to impacted areas.
Efficiency What will be the costs, risks, and benefits of changes in impact assistance programs?	Economic costs and benefits	High economic costs, due primarily to increased water and sewer grants activity and higher levels of federal/regional impact assistance. Direct distribution of land and mineral payments to impacted areas costs states, counties, and school districts the equivalent amount of revenue.
	Risk of loss or failure	Risk of loss of investment if development fails to materialize is minimal for impacted communities and high for the federal government.
	Social costs and benefits	Increased impact assistance contributes to better quality of life, thereby reducing labor turnover and construction delays and increasing productivity.
	Environmental costs and benefits	Special water and sewer programs will ensure that fewer and/or more adequately treated effluents are released into rivers and streams.
Equity How will these costs, risks, and benefits be distributed?	Costs	Costs would be distributed more widely among all levels of government. Taxpayers generally rather than residents of energy-impacted communities would pay costs of development.
	Risks	Overall, risks are greatest for the federal government and taxpayer since funds would be appropriated by Congress as grant assistance or loan assistance with payback forgiveness provisions if development does not occur.

TABLE 9-14: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity (Continued)	Benefits	Immediate benefits go to impacted communities; in the long term, benefits are distributed more widely as adequate supplies of energy are made available.
Flexibility Is the alternative sufficiently flexible to be applicable under a variety of conditions and over time?	Adaptability	Federal and regional impact assistance can deal with a broad range of impact needs. Flexibility of land and mineral payment distribution alternatives limited by total allocation of funds to states. Special water and sewer programs are functionally specific, giving them the lowest flexibility.
	Adjustability	Federal and regional impact assistance can accommodate a variety of administrative options. Each alternative in this category can be used in conjunction with other alternatives.
Implementability How difficult will it be to implement the alternative?	Acceptability	Acceptability depends on implementation strategy. Increases in federal and regional impact assistance involve only incremental changes in existing programs, but could draw opposition from nonwestern regions. Water and sewer grants limited to nonmetropolitan areas would arouse suburban opposition. Direct federal distribution of land and mineral payments would be opposed by states, counties, and school districts.
	Ease of administration	Federal assistance programs and land and mineral payment programs are already in place. Policymakers only need change administrative criteria. Water and sewer programs require more attention to criteria in order to direct funds to nonmetropolitan areas.

TABLE 9-15: SUMMARY AND COMPARISON OF GROWTH MANAGEMENT ALTERNATIVES

CRITERIA	MEASURES	FINDINGS
Effectiveness How effective will changes be in providing adequate revenue for local services and facilities?	Dollar value of assistance compared to needs	While both categories of alternatives have the potential to increase revenues available to impacted communities, increases in impact assistance are more effective in dealing with needs across the study region. The amount of assistance available from changes in the tax structure is less certain and depends on the tax base and rate of taxation. Total assistance could exceed $150 million.
	Timing of assistance	Changes in the tax structure in the form of prepayment of taxes are designed to overcome or mitigate "lead-time" problems. Impact assistance measures can be designed to meet the front-end needs of impacted communities.
	Distribution of assistance	Both categories of alternatives will improve the distribution of assistance in favor of impacted communities.
Efficiency What will be the costs, risks, and benefits of the alternatives?	Economic costs and benefits	Changes in tax structure generally involve fewer economic costs because existing financial resources are reallocated.
	Risk of loss or failure	Impact assistance and land and mineral payment alternatives involve minimal risk to impacted communities; some tax structure changes could be risky if development fails to materialize.
	Social costs and benefits	Both categories of alternatives contribute to better quality of life, thereby reducing labor turnover and construction delays and increasing worker productivity.
	Environmental costs and benefits	No environmental costs are apparent; environmental benefits most likely to result from special water and sewage treatment programs for rapid-growth areas.
Equity How will these costs, risks, and benefits be distributed?	Costs	Alternatives to change the tax structure are more likely to ensure that direct beneficiaries of energy development bear a share of the cost; however, the equity of some severance tax rates has been questioned.
	Risks	The two categories of alternatives compare favorably in the degree to which they spread risks among various sectors of society. Alternatives to increase impact assistance spread risks at the federal level, whereas changes in the tax structure distribute risks on a localized basis.

TABLE 9-15: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity (Continued)	Benefits	With either category of alternatives, immediate benefits would accrue to impacted communities when they receive additional revenue to deal with the effects of energy resource development. Increased levels of sources and facilities would contribute to improved quality of life for both temporary and permanent residents of energy communities. In the long term, energy consumers would benefit from increased supplies of electricity, gas, and oil.
Flexibility Is the alternative sufficiently flexible to be applicable under a variety of conditions and over time?	Adaptability	Overall, increases in federal and regional impact assistance programs can be most easily adapted to a variety of impact needs in western communities. However, other alternatives in this category are limited by the nature of the program. Changes in the tax structure could be tailored to a variety of state and local conditions.
	Adjustability	Alternatives in both categories can be used either interchangeably or in conjunction with each other. There appear to be few constraints to choosing various alternatives for achieving the objective of increasing revenues for impacted communities.
Implementability How difficult will it be to implement the alternative?	Acceptability	The incremental nature of increases in impact assistance and the fact that such programs are already in place makes them more acceptable than changes in state and local tax structures. Since tax structure changes reallocate revenue, they are likely to be opposed by government or company giving up or losing direct control over revenue. However, ultimate outcome of some alternatives for changing impact assistance will depend on the particular implementation strategy chosen.
	Ease of administration	The uniformity of changes in impact assistance alternatives and the fact that they primarily extend existing programs makes them easier to administer. Tax change alternatives must be administered on a state or local basis because of variations in state tax laws.

9.4.1 How Much Impact Assistance Would these Alternatives Provide?

Both categories of alternatives have the potential for increasing revenues available to impacted communities. However, methods of increasing impact assistance through existing or new programs promise to be more effective in supplying the amounts of assistance needed. Changes in the tax structure--particularly prepayment of taxes by industry--are the most direct and effective means of dealing with the "front-end" problem of impacted communities and providing them with financial assistance when they need it. Both categories of alternatives will improve the distribution of financial assistance by providing funds directly to the jurisdisctions that must deal with the problems of rapid growth.

9.4.2 What Will these Alternatives Cost?

The economic costs of increasing impact assistance will be greater than those of changing the tax structure since the latter primarily involves reallocation of existing financial resources. Economic and social benefits will accrue to impacted communities under both categories of alternatives. Risk of loss or failure will be greater under some of the tax structure alternatives (e.g., prepayment). Special water and sewer grants (under the category of increased assistance) promise the greatest environmental benefits. No significant environmental costs are apparent.

9.4.3 Who Bears the Costs, Risks, and Benefits?

The equitable distribution of the costs, risks, and benefits of energy development in the West is primarily a function of the degree to which the direct beneficiaries of such activity also bear a portion of the attendant costs. It generally appears that alternatives to change the tax structure are more likely to ensure that the direct beneficiaries of energy development share in the costs of the impacts. However, for each of the specific growth management alternatives, policymakers will have to weigh a number of considerations in determining what is the most equitable policy. The state severance tax alternative, for example, reveals the difficulty involved in making judgments of equity in this policy analysis. Montana has imposed a 30 percent severance tax on coal to defray the impact of development and the future effects of resource depletion. While state officials defend the tax as a responsible public policy, eastern utilities argue that the 30 percent rate is excessively high. It seems likely that the resolution of this, and other questions of equity will depend primarily on the values, preferences, and perspectives of individual policymakers, as well as the context of specific energy development situations.

9.4.4 How Flexible Are the Alternatives?

Increases in federal and regional impact assistance programs appear to be more adaptable to the variety of impact needs of western communities than changes in the tax structure, although the latter can be designed to meet unique needs. Both categories of alternatives are capable of being easily adjusted to specific situations and to use with other alternatives.

9.4.5 Can these Alternatives Be Implemented?

Changes in existing federal impact assistance programs will be easier to effect since several of these specific alternatives involve only incremental changes in existing federal policy. For this category of alternatives, the implementation strategies chosen will, in large part, determine the acceptability of a particular policy choice. If special water and sewer grant programs for rapid-growth areas include fast-growing metropolitan suburbs, they can probably be implemented quite easily. On the other hand, if the availability of these special grants is restricted to nonmetropolitan areas, the suburbs are likely to raise strong objections. The choice of strategies will also affect the implementability of the policy alternatives calling for federal and regional impact assistance. If impact funds are provided only to regional commissions in the West, other regional commissions may also demand funds.

The transfer of various impact assistance functions to higher levels of government generally involves greater uniformity in administration and less flexibility and control over revenue sources by state and local governments. Thus, several of the alternatives for changing jurisdictional control over revenue sources also could potentially lead to political problems, since state and local governments view the loss of control as a reduction in their flexibility to address energy impacts, and they also see their authority threatened. For example, counties are likely to resist the municipal annexation of rural land, since that act would infringe upon their sovereignty. Local governments will also likely oppose state collection and distribution of property taxes on energy facilities, since this preempts their ability to set local taxing and spending priorities. State governments will feel threatened if land and mineral payments are made directly to local governments, rather than to the states, since the state has traditionally had the authority to decide how these funds would be allocated between state and local governments.

Although this summary and comparison of two categories of growth management alternatives identifies for policymakers the range of problems and issues involved in alleviating the socio-economic impacts of energy resource development in the West, it is also apparent that this analysis cannot resolve all of the questions that are likely to be raised in making choices to address these problems and issues. This is true in part because important information is lacking. For some specific alternatives, there is too little current experience to judge the effect a policy will have on energy impacts. This lack of information affects what alternatives are evaluated as well as how they are evaluated.

In addition, this policy analysis is affected by the fact that much experience with policy alternatives is unique to particular areas; therefore, few generalizations can be made that are applicable to other energy development sites in the West. Finally, policy analysis of growth management problems and issues is pervaded by uncertainty, both about the identification of the impacts of energy development and about how information can be gathered on such impacts. Uncertainty about the nature of socioeconomic impacts makes it difficult for policymakers to predict and plan for population growth from energy development and to manage local public service needs resulting from such growth.

CHAPTER 10

CAPITAL AVAILABILITY

EXECUTIVE SUMMARY

Expanded western energy production will require an unprecedented level of capital investment in the eight-state western region. In order to provide the capital necessary for extraction, conversion, and transportation facilities, several uncertainties will have to be reduced or resolved; these include technical, economic, regulatory, and institutional factors.

Impacts

In order to produce about 125 quadrillion British thermal units (Btu's) (125 Q's) nationally, about 42 Q's will need to be produced from the eight-state region by the year 2000, according to the modified Stanford Research Institute Low Demand case used in this study. This western production will require a capital investment of about $130 billion (1975 dollars) from 1975 through 2000. This amount is less than 3 percent of the total national investment projected by the year 2000. Thus, western energy resource development probably will not be so large as to deplete noticeably the national supply of financial resources. However, the projected capital need is unprecedented within the West. By comparison, total private investment in equipment and structures in place in Federal Region VIII, which includes all of the eight states except Arizona and New Mexico, was only $31.2 billion as of 1973.

Individual energy projects are separate investments and each must prove its commercial feasibility to attract investment capital. Many energy facilities planned for the West, especially advanced conversion technologies, require an investment over $1 billion each (Table 10ES-1). Such large facilities are equivalent to almost the entire fixed investment of many large energy development firms. The risk involved in such large facilities has a large influence on the availability of financing for such projects.

The Policy Context

Capital availability for energy development could be limited by several uncertainties and risks. Risks associated with large

TABLE 10ES-1: CAPITAL REQUIREMENTS FOR ENERGY FACILITIES
(millions of 1975 dollars)

FACILITY	MATERIALS AND EQUIPMENT	LABOR AND MISCELLANEOUS	INTEREST (construction)	TOTAL
Mines				
Surface Coal (12 MMtpy)	64	35	30	129
Underground Coal (3.4 MMtpy)	35	21	20	76
Uranium Mining and Milling (1,000 mtpy)	8	16	6	30
Conversion				
Electric Power (3,000 MWe)	459	459	351	1,169
Gasification (250 MMcfd)	469	369	219	1,057
Synthoil (100,000 bbl/day)	1,065	649	695	2,409
Oil Shale (100,000 bbl/day)	434	381	296	1,111

MMtpy = million tons per year
mtpy = metric tons per year
MWe = megawatt-electric
MMcfd = million cubic feet per day
bbl/day = barrels per day

energy projects can raise the interest rate necessary to attract investment to a level at which the project becomes economically infeasible. The most substantial risks affecting western energy resource development appear to be:

- Technical; including uncertain performance of new technologies at commercial scale, relatively low investment in research and development by the energy industry, and the capital investment required for large commercial-sized plants.

- Economic; including the world energy market and its effect on the economic viability of advanced energy technoligies and federal policies concerning energy pricing. In addition, uncertainty over federal air quality and fuel-switching policies makes demand for western coal and investment in western energy development relatively risky.

- Governmental and institutional uncertainties; including the large number of regulatory and administrative approvals required for energy facilities; the imposition of severance taxes on energy minerals; and the degree of control which Indian tribes might have on energy development. These factors add to the time or cost of energy development, thereby increasing financial risk to investors.

In response to these risks, energy developers and financial institutions have developed various strategies. In the electric utility industry, long-term fuel supply contracts and power-pooling have become commonplace to assure a reliable electricity supply. Gas utilities have reserves dedicated to them by producers and require long-term "take of pay" contracts with distributing companies. Financial institutions are moving increasingly to project financing, which attempts to assure that projects and not just corporations are financially sound. Thus, joint ventures and consortia are becoming common in western energy development in an attempt to keep the risks low enough to the individual companies and to maintain a financially attractive project.

In addition to the risk considerations in western energy projects, concern over the lack of competition and monopoly practices in western energy development have been raised. Since large oil companies are acquiring large holdings of coal and uranium reserves in the West, and little, if any, production has taken place, large firms have been accused of trying to close off competition from new energy forms by holding other energy resources. Energy developers generally have the view that only large, diversified firms have enough capital and technical expertise to do the job in western energy development.

Alternative Policies

Given the uncertainties of western energy development projects, the financial risks are usually greater than those of other investment opportunities, which in turn raise the cost of obtaining financial backing for western ventures. Hence, one policy objective is to assure the availability of investment capital for western energy development. To meet this goal, three categories of policy alternatives are identified:

- Provide financial subsidies to developers;
- Improve regulatory environment;
- Promote new sources of investment.

Several specific alternatives are available for each of these categories (Table 10ES-2). For example, financial subsidies include tax preferences and price guarantees. Regulatory changes produce greater certainty about pricing and permitting. The price regulation/deregulation options differ from subsidies in that the energy market would determine the actual price level, in contrast to a price "floor" guaranteed by the government regardless

TABLE 10ES-2: CAPITAL AVAILABILITY ALTERNATIVES

OBJECTIVES	CATEGORIES OF ALTERNATIVES	SPECIFIC ALTERNATIVES
Assure adequate capital for western energy development	Provide financial subsidies to developers	Tax preference Price guarantees
	Improve regulatory environment	Expedite siting and permit process Deregulate oil and gas prices Permit rolling-in for synthetic fuels
	Promote new sources of investment	Consumer risk assumption for energy projects Encourage new participants by improving the leasing system

of the market price. Both approaches could reduce risks to investors by eliminating uncertainty over future energy prices. The time-consuming energy facility siting and permitting process is responsible for a large share of the cost of new energy facilities. An expedited permit process could make the length of time involved more certain and reduce the financing (interest) cost of a project.

New sources of investment could bring different participants into the financing of western energy development. The federal government, Indian nations, energy consumers, and small firms each could provide an increased amount of investment in western energy development. These new sources might be experimental within selected situations, although none would be able to substitute completely for the traditional participants in western energy development. Utility consumers could assume a major portion of the economic risk of new projects if project costs could be recovered in consumer energy rates. A similar procedure, called an "all-events tariff" on customer bills, has been proposed as a means for supporting coal gasification projects. Small firms could be encouraged to participate in western energy development through special financial subsidies, such as those discussed generally above, and by special regulations and procedures for small firms to acquire federal energy resource leases.

Findings

Financial subsidies can relieve many of the risks associated with western energy resource development. Price guarantees are particularly appropriate for removing investor risks by transferring market-price uncertainties and liability to the government. Tax preferences, especially investment tax credits, reduce capital exposure risks by allowing the developer to recapture part of the capital investment almost immediately.

Financial subsidies could result in large governmental expenditures, depending on the duration of the guarantee and the relationship between the market price and guaranteed price. For example, one study estimates that a price guarantee program for a 50 thousand barrel per day shale oil plant could cost the government a net present value of $150 million (for a 15 percent rate of return) to $625 million (for a 20 percent rate of return) over a 20-year period, assuming a constant price of world oil. Government liabilities to support synthetic coal facilities could also be quite large. Current estimates for coal gasification suggest prices would have to be guaranteed at about $1.30 (per million Btu's) over the price of Alaskan gas and about $3.25 over the price of domestic gas. Thus a 250 million cubic foot per day gasification plant would require a subsidy of about $110 million, roughly the entire annual operating cost for such a facility.

Taxpayers would ultimately pay for governmental subsidies. In one sense, this represents an equitable sharing of costs and, over a long period of time, an equitable sharing of the benefits of technological improvement and, perhaps, reduced dependence on foreign energy sources. However, price guarantees and tax preferences would almost certainly benefit larger companies, since they reduce investment risks but do not help small firms raise the necessary initial capital. Financial subsidies will continue to face substantial opposition from many public interest groups and national legislators, since they are viewed as support to "special interests" such as oil companies.

Alternatives for promoting new capital sources could be used in conjunction with financial subsidies to encourage investment by smaller firms. Resource leasing options may stimulate investment in the long run by making current regulatory procedures more orderly. In the short run, development may be impeded as private firms and public regulators adjust to new "rules of the game." In some cases, firms may have to pay higher royalties, which would discourage some development.

Consumer risk assumption alternatives, such as an all-event tariff, shift most financial risks away from developers and increase consumer costs, at least over the short term. However, this alternative is intended to be applied on an individual project basis in order to simulate new technological developments, with the goal of self-supporting operations over the longer term.

Conclusion

Perhaps the capital availability problem is best illustrated by the fact that despite the 1973 Arab oil embargo and subsequent efforts by government to encourage exploitation of domestic energy resources, not one commercial oil shale or coal synthetic fuel plant has been built. Such facilities require an investment on the order of $1 billion per plant, equivalent to the entire fixed investment of many large energy firms. So far, no company has been willing to accept such a risk in the face of the technical, economic, and regulatory uncertainty involved. If government wishes to increase domestic energy production by utilizing these newer technologies, then it appears that some type of government program, such as those discussed here, will be necessary to reduce the risks involved.

CHAPTER 10

CAPITAL AVAILABILITY

10.1 INTRODUCTION

Expanding western energy production to meet national needs will require an unprecedented level of capital investment in the eight-state study area. Between 1975 and the year 2000, energy extraction, conversion, and transportation facilities could require an investment of up to $116 to $130 billion (in 1975 dollars).[1] Although this sum is less than 3 percent of the investment capital expected to be available nationally during this time period,[2] there is serious question as to whether this amount of capital can be made available for western energy development at the necessary rate and scale. Several major factors affect the availability of this capital, including technological uncertainties associated with large-scale synfuels conversion facilities, market uncertainties related to energy pricing, the economic interests of large energy firms, and a restricted and unstable regulatory situation. These factors can pose two kinds of obstacles for western energy resource development: financial risk and monopolized energy markets.

A major condition for capital availability is that private sector investors be convinced that the energy projects proposed for the West will be at least as profitable and secure as other investment opportunities. In financial markets, uncertainty per se has economic consequences. Investors can usually be brought into high-risk ventures only if enticed by "risk premiums" which offer a higher rate of return than the investor can expect from more secure investments. A further obstacle to western energy development is a tendency toward monopoly or oligopoly among large, diversified energy firms. Oil and gas companies have acquired substantial portions of other energy resources, such as coal and uranium. This raises concern over the possibility that by controlling raw materials and process technologies these firms could control future energy supply and prices. On the other hand, there is also the opinion that these firms are the only energy investors with sufficient capital and expertise to commercialize technologies for synthetic fuels from coal and oil shale.[1]

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[1] This amount corresponds to the adjusted Low Demand Case for western energy development described in White, Irvin L., et al. Work Plan for Completing a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1978, pp. 8-11. This case calls for production of 1.32 billion tons of coal, 38 thousand tons of yellowcake per year, and 2.5 million barrels of shale oil per day by the year 2000 in the eight-state study area.

[2] Assuming long-term trends persist, $4,710 billion dollars would be available for new plant and equipment expenditures over the period 1976-2000, of which western energy would represent about a three percent share. See White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. II, pp. 847-63.

This chapter identifies some of the barriers to capital availability, including the risk and lack of competition discussed above. The next section details the impacts of western energy development on national capital markets and the problems and issues surrounding capital availability. The final section identifies and evaluates some policy alternatives for dealing with the problems and issues related to making capital available for western energy resource development.

10.2 CAPITAL AVAILABILITY PROBLEMS AND ISSUES

10.2.1 The Capital Availability Impacts of Western Energy Resource Development

The major capital availability questions addressed in this chapter are: (1) what total capital investment will be required for western energy development and (2) will national capital markets be capable of meeting this requirement?[2]

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[1] See Sanger, Herbert, Jr., and William E. Mason. The Structure of Energy Markets: A Report of TVA's Antitrust Investigation of the Coal and Uranium Industries, 3 vols. Knoxville, Tenn.: Tennessee Valley Authority, June 1977.

[2] White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Chapter 12; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

The Low Demand Case of the Stanford Research Institute (SRI)-Gulf interfuel competition model was taken as a plausible scenario for the regional scale of development.[1] This case calls for the production of 1.3 billion tons of coal and 38 thousand tons of yellowcake per year and 2.5 million barrels of shale oil per day by the year 2000 within our eight-state study area.[2] To determine the capital investment required, capital cost estimates were made for the major facilities that would be required in the eight-state region to produce this quantity of energy.[3] This resulted in an estimated total capital cost of construction over the first 25 years of $128 billion (Table 10-1). In terms of national investment in all industries, this is less than 3 percent of new plant and equipment projected for installation by the year 2000. These estimates indicate, therefore, that western energy resource development will not have a large effect on the availability of financial resources nationally.

Nevertheless, the projected capital need of $128 billion is unprecedented in scale for the study area. By comparison, total equipment and structures owned by private business (including farms) in Federal Region VIII (Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming) was only about $31.2 billion as of 1973.[4] Therefore, energy development can be expected to induce a large expansion in the western economy. At least in the initial stages, most of the manufactured equipment and financial resources going to western energy will come from outside the region.[5]

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[1] Cazalet, Edward G., et al. A Western Regional Energy Development Study: Economics, Final Report. Menlo Park, Calif.: Stanford Research Institute, 1976, Vol. 1.

[2] Modifications to the Low Demand Case were made, as described in White, Irvin L., et al. Work Plan for Completing a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1978, pp. 8-11. These modifications lower the level of oil shale and add geothermal development.

[3] The cost data were taken principally from Carasso, N., et al. The Energy Supply Planning Model, 2 vols. San Francisco, Calif.: Bechtel Corporation, 1975.

[4] Federal Region VIII corresponds to our study area except that it does not include the states of New Mexico or Arizona. Data estimated from U.S., Department of Commerce, Bureau of the Census. The Statistical Abstract of the United States. Washington, D.C.: Government Printing Office, 1975, Table 675 and Section 33.

[5] The new Bucyrus-Erie plant for manufacturing draglines in Pocatello, Idaho, may be indicative of a growing westward shift of mine equipment manufacturers.

TABLE 10-1: POTENTIAL NEW PLANT INVESTMENT IN WESTERN ENERGY (billions of 1975 dollars)

ENERGY DEVELOPMENT ACTIVITY[a]	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	1976-2000
Gasification	0	.7	4.9	13.8	23.7	43.1
Oil Shale	.3	1.6	3.2	7.0	16.1	28.2
Mine-Mouth Power	7.6	3.8	2.5	1.2	1.2	16.3
Surface Mining	1.7	1.7	2.0	2.6	3.3	11.3
Transportation	5.1	4.1	4.8	6.5	8.7	29.2
TOTAL	14.7	11.9	17.4	31.1	53.0	128.1
National new plant, all industries[b]	648	770	914	1086	1289	4707
Western plant as percentage of new plant nationally	2.26	1.54	1.90	2.86	4.11	2.72

[a] This level of energy development corresponds to the modified Stanford Research Institute Low Demand Case, calling for production of 1.3 billion tons of coal and 38 thousand tons of yellowcake annually and 2.5 billion barrels of shale oil per day by the year 2000 in the eight-state region. See White, Irvin L., *et al*. *Work Plan for Completing a Technology Assessment of Western Energy Resource Development*. Washington, D.C.: U.S., Environmental Protection Agency, 1978, pp. 8-11.

[b] New plant and equipment expenditures assumed to be 7.8 percent of Gross National Product, which is assumed to grow by 3.5 percent per year. The figure of 7.8 percent is the average from 1966-1975, as reported in the "New Plant and Equipment Expenditures." *Survey of Current Business*. Washington, D.C.: U.S., Department of Commerce, various issues.

From the perspective of the national economy, money markets can easily finance western energy development at this scale. Therefore, this study has focused on the question of whether western energy projects are likely to be able to obtain sufficient capital. This is largely a question of the commercial viability of particular western energy development projects. Although many investors could invest in energy development, they are not likely to do so unless they expect the ventures to be at least as profitable and/or as secure as other investment opportunities.

Facility size is a key determinant of how well the financial risks can be handled. Initial studies indicate that the unit cost of conversion facilities will be a decreasing function of plant size.[1] This would give an economic advantage to larger plants. The capital costs of various facilities are estimated in Table 10-2. These facilities are large compared to current average practice (and some don't exist at any commercial scale), but these sites are expected to be within the range of possibility during the time horizon of this study. As noted in the table, conversion facilities are likely to cost over $1 billion each.

Such large facilities require a capital investment out of the reach of many would-be developers. Table 10-3 lists a sample of firms which have made various degrees of commitment to western energy development. A $1 billion project would be approximately the entire fixed investment of many of these firms. Thus, the performance of these facilities would have a strong influence on the entire company, and pose a substantial financial risk.[2]

The next section discusses the political and regulatory context of capital availability for western energy development. Two topics are given emphasis: financial risk and market competitiveness.

10.2.2 The Context of Capital Availability Issues in the West

A. Financial Uncertainties

The major risks facing energy developers can be classified as technical, economic, governmental, and institutional. Technical risks include equipment failure and operation problems, as well as unforeseen problems with new technologies such as synfuels plants. Economic uncertainties, such as labor disputes and trouble with financing, also include uncertainties about the price competitiveness of synthetic fuels with oil and gas. Governmental and institutional uncertainties include regulations and requirements that may change during the course of a project, legal challenges by opposition groups, and lead times for complying with federal, state, and local procedures. These sets of factors are presented in Table 10-4 as they affect power plant construction. Their effects on synthetic fuels plants are as yet unknown, but are likely to be larger for these new technologies. The three

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[1] U.S., Federal Energy Administration. Project Independence Blueprint Final Task Force Report--Synthetic Fuels from Coal. Washington, D.C.: Government Printing Office, 1974, p. 38.

[2] A rule of thumb for the size of individual investments is that they should be no more than 40-50 percent of a firm's assets. The Alcan pipeline accounts for about 40 percent of its backers' assets and is considered to be about as large as can be justified. "Financing: The Real Test for Alcan Pipeline." Business Week, November 28, 1977, pp. 102-4.

TABLE 10-2: CAPITAL RESOURCES REQUIRED FOR CONSTRUCTION OF A FACILITY (millions of 1975 dollars)

FACILITY	SIZE	MATERIALS AND EQUIPMENT	LABOR AND MISCELLANEOUS	INTEREST DURING CONSTRUCTION[a]	TOTAL
Mines					
Surface coal	12 MMtpy	64	35	30	129
Underground coal	3.4 MMtpy	35	21	20	76
Uranium[b]	1,000 mtpy	8	16	6	30
Conversion					
Power	3,000 MWe	459	459	351	1,169
Gasification	250 MMcfd	469	369	219	1,057
Synthoil	100,000 bbl/day	1,065	649	695	2,409
Shale oil[c]	100,000 bbl/day	434	381	296	1,111

MMtpy = million tons per year
mtpy = metric tons per year
MWe = megawatt-electric
MMcfd = million cubic feet per day
bbl/day = barrels per day

Source: Linearly scaled from data in Carasso, M., et al. The Energy Supply Planning Model, 2 vols. San Francisco, Calif.: Bechtel Corporation, 1975.

[a] At 10 percent per year.

[b] Mining and milling to yield U_3O_8 (yellowcake).

[c] Mining, retorting, and upgrading.

TABLE 10-3: REPRESENTATIVE FIRMS IN WESTERN ENERGY

FIRM	HEADQUARTERS	MAJOR LINE OF BUSINESS	LAND AND EQUIPMENT (millions of 1975 dollars)
Electric Utilities			
Commonwealth Edison	Chicago, Illinois	Electric Utilities	5,045
Montana Power	Butte, Montana	Electric Utilities	482
Pacific Power and Light	Portland, Oregon	Electric Utilities	1,579
Southern California Edison	Rosemead, California	Electric Utilities	3,973
Utah Power and Light	Salt Lake City, Utah	Electric Utilities	842
Gas Utilities and Pipelines			
American Natural Resources	Detroit, Michigan	Gas Utilities	1,773
El Paso Company	El Paso, Texas	Gas Utilities	1,788
Northern Natural Gas	Omaha, Nebraska	Gas Utilities	1,248
Peoples Gas	Chicago, Illinois	Gas Utilities	1,571
Texas Eastern Transmission	Houston, Texas	Gas Utilities	1,979
Mining/Oil/Energy			
Amax	Greenwich, Connecticut	Metal Mining	1,467
Ashland Oil	Russell, Kentucky	Oil	953
Atlantic-Richfield	Los Angeles, California	Oil	4,925
Continental Oil	Stamford, Connecticut	Oil, Coal	2,802
Kerr-McGee	Oklahoma City, Oklahoma	Energy	803
Peter Kiewit Sons	Omaha, Nebraska	Construction	423[a]
Occidental Petroleum	Los Angeles, California	Oil	1,928
Standard Oil Indiana (AMOCO)	Chicago, Illinois	Oil	6,413
Superior Oil	Houston, Texas	Oil Production	496
United Nuclear	Elmsford, New York	Uranium	97

[a] Sales.

TABLE 10-4: CAUSES OF DELAY IN POWER PLANT CONSTRUCTION

CAUSE	NUMBER OF UNITS	CAPACITY (thousands of megawatts)
Technical Factors		
Equipment delay or failure	71	25.1
Initial operation problems	13	2.4
	84	27.5
Economic Factors		
Financial problems	53	29.8
Labor or vendor disputes	44	27.6
	97	57.4
Institutional Factors		
Changes in regulations	28	31.0
Legal challenges	43	26.3
Federal procedures	35	29.5
State and local procedures	34	8.7
	140	95.5
Other	99	49.5
Total	420	229.9

Source: 1975 Federal Power Commission data cited in Environmental Policy Institute. The Need for Energy Facility Sites in the U.S. Washington, D.C.: Environmental Policy Institute, Appendix F.

types of risks are discussed below with emphasis on synthetic fuels facilities.

(1) Technical Uncertainties

Technical uncertainties are magnified for new technologies, such as oil shale retorting and coal gasification. These technologies are still untested at a commercial scale, and the consequences of unforeseen problems are further enhanced by the large size of the facilities needed for commercial viability.

The capital intensity and large size of conversion facilities result in a large capital investment requirement, often an investment which, as noted earlier, exceeds the total assets of some developers. As one analyst has stated, "No longer can an oil company or utility routinely budget these increments, and even the best-heeled diners at the Petroleum Club will hardly feel their manhood threatened if they respectfully decline to reach into their jeans for a one-eighth share of such a staggering total [investment]."[1]

The federal government shares development risks with the private sector on new energy technologies by funding a large amount of energy research. The $4.245 billion budget proposed for research by the Department of Energy (DOE) for fiscal year (FY) 1979 represents 15.2 percent of the total federal research effort. The only department with a larger research and development budget is the Department of Defense.[2]

DOE's new organizational structure recognizes the progression of innovation from basic research through commercialization. Basic research is conducted in the Office of Energy Research, and projects on specific supply technologies are developed in the Office of Resource Applications or the Office of Conservation and Solar Applications. A Research and Development (R&D) Coordination Council is to achieve coordination among the various programs.[3]

Federal support will probably be shifting more toward basic research since this is an area in which business underinvests because the payoff is too far in the future and the output is more useful to society as a whole than to individual companies.[1] Moreover, progression toward commercialization requires performance evaluations at increasingly larger scales, making commercial projects more suited to joint public-private ventures.

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[1] Stelzer, Irwin. "Capital Requirements for Energy Development in the Western States Region." Paper presented at the National Conference on Financial Requirements for Energy Development, Albuquerque, New Mexico, October 30, 1975.

[2] Greenberg, Daniel. "New R&D Budget: A Boost But No Bonanza." Science and Government Report, Vol. 8 (February 1, 1978), p. 2.

[3] Bachman, W.A. "DOE Takes Command of U.S. Petroleum Destiny." Oil and Gas Journal, Vol. 75 (October 3, 1977), pp. 47-52.

There are still many risk factors even in the later stages of development. Not the least of these are the increasingly larger facilities--from bench to pilot to demonstration models--which require larger concentrations of capital. Federal efforts appear to be concentrated on reducing technical uncertainties early in a technology's development. Economic and governmental uncertainties are most critical at the commercialization stage.

(2) Economic Uncertainties

The economic uncertainties facing western energy developers are those which can alter demand conditions. The uncertainties include the world energy market, federal and state regulatory commissions, and national energy and environment-oriented fuel policies. Although each of these has strong institutional features, they are grouped together here because they are determinants of business climate rather than of specific projects.

Organization of Petroleum Exporting Countries (OPEC) prices for a barrel of oil are now the international energy-pricing yardstick. Since these prices are well above OPEC's production costs, this yardstick price could be lowered by the cartel or if the cartel disintegrated. While this would benefit consumers, it could be costly for investors in energy developments which have a high production cost, such as in coal gasification and oil shale developments. The uncertainties over prices make investors reluctant to develop new energy technologies despite apparent profit opportunities.

Federal regulation of natural gas prices has considerable effect on the prices paid by consumers. The Federal Energy Regulatory Commission (FERC) determines prices to be charged for interstate sales of natural gas, and also decides whether new transmission facilities are needed.[2] Current proposals to change regulatory procedures or to deregulate natural gas prices by

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[1] "Major Excerpts from Frank Press Briefing." Science and Government Report, Vol. 8 (February 1, 1978), pp. 3-4.

[2] The Natural Gas Act, Pub. L. 75-688, 52 Stat. 821, 15 U.S.C. § 717, established federal regulation of gas; and the Department of Energy Organization Act, Pub. L. 95-91, 91 Stat. 565, transferred it from the Federal Power Commission (FPC) to the FERC.

1985[1] could substantially change the competitive viability of synthetic gas made from coal. As sources of easily exploitable gas have become scarce in recent years, pipeline companies have responded by seeking supplemental sources such as imports by pipeline from Canada and Mexico, imports in the form of liquefied natural gas (LNG), and synthetic natural gas (SNG). These have come only at much higher costs than fuels from conventional domestic sources. This has raised difficult pricing issues for the FERC. The traditional pricing method had been to "roll in," or average together, the costs of all sources to a pipeline company. With the advent of expensive, supplemental sources in 1972, the Commission switched to an incremental method of pricing. Under this system, users of the new gas pay the full cost of the new gas.[2] Although this policy has since been nullified, by this order the Commission signaled its intent to (a) discourage the use of high-cost supplements, (b) give incremental users an incentive to seek alternative sources of energy, and (c) put the costs on those who receive the benefits.[3]

These considerations will apply to western energy development in the case of SNG. FERC has jurisdiction over coal gasification facilities through the pricing of SNG. For example, when considering certification for a new pipeline, the Commission may attach conditions limiting the price paid for SNG sources feeding that pipeline.[4] Recent proposals by DOE could directly improve the viability of the first commercial coal gasification plant. In addition to rolled-in pricing, the proposals include provisions to recover the investment through higher consumer rates if the project is not completed or is abandoned. Thus, an "all-events tariff" would have consumers guarantee the plant through higher bills.[5] Rolled-in pricing, in particular, could make SNG attractive since pipeline companies could spread the extra cost of the comingled gas among all their customers. Similar stimulation could make oil shale development attractive. Shale oil prices have always been projected to be above market oil prices (see box entitled "Shale Costs Keep Rising"). This type of federal insurance or guarantee indicates that the federal government actually intends to promote synthetic fuel development.

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[1] "Conferees Accept Gas-Compromise Bill." Oil and Gas Journal, Vol. 76 (May 29, 1978), p. 45.

[2] FPC Order No. 622, June 28, 1972.

[3] Columbia LNG Corp. v. FPC. 491 F. 2d 651 (1974).

[4] As was done in Transwestern Coal Gasification Co., FPC Opinion No. 728, April 21, 1975.

[5] "DOE Backs First Coal Gasification Plant." Oil and Gas Journal, Vol. 76 (June 12, 1978), p. 22.

State utility commissions have jurisdiction over intrastate markets, which are relatively more important in the case of electric utilities. Authorizing legislation has not spelled out pricing formulas in any detail, so that courts have given state commissions wide latitude, subject only to the standard that "the return to the equity owners should be commensurate with returns on investments in other enterprises having corresponding risks."[1] In interpreting such guidelines, most utility regulators seem to have concluded that shortages and blackouts are less tolerable to consumers than higher prices. The Supreme Court's standard in the Hope case also gives support to a risk-minimizing approach, emphasizing "successful operation," "financial integrity," and "attracting capital."[2]

SHALE COSTS KEEP RISING

In 1970, a Cabinet task force estimated that shale oil could be produced for about $4 a barrel; in 1973, estimates were made of $5.60; in 1974 the cost was figured at $6.80; in 1975 estimates ran in the neighborhood of $15. Superior Oil Company now claims that Number 6 oil can be produced for no more than $15/barrel, but the economics depend on credits being assumed for other products being recovered from the ore. Superior wants to go ahead with a 13,000 barrel/day plant, but has been held up since 1970 by negotiations for a land swap with the Bureau of Land Management. Upon completion of Interior Department approvals, 7 to 9 years would be needed to bring the plant on line.

--Weidenbaum, Murray, & Reno Harnish. Government Credit Subsidies for Energy Development. Washington, D.C.: American Enterprise Institute for Public Policy Research, 1976, p. 6; and Bureau of National Affairs. "Interior Policy, EIS Delay New Oil Shale Demonstration Plant." Energy Users Report, Current Report No. 190 (March 31, 1977), p. 16.

Two other significant demand uncertainties affect the level of western coal development. Some recent policies have decreased the attractiveness of western coal as a means for meeting air quality standards. The 1977 Clean Air Act Amendments, for example, require that all coal-fired facilities, regardless of the sulfur content of the coal burned, be equipped with the "best available control technology" for removing sulfur oxides from flue gases.[1] This policy could reduce the demand after 1990 for Northern Great Plains coal to only half of what was anticipated.[2] The Environmental Protection Agency (EPA) has not yet developed regulations under the new act, so some ambiguity about the final requirements and effects remains.[3] This uncertainty makes investment in western coal mines more risky than had previously been the case.

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[1] FPC v. Hope Natural Gas Co., 320 U.S. 605 (1944). In this case, the Supreme Court interpreted ratemaking sections of the Natural Gas Act.

[2] Ibid.

The second policy that affects western energy development is mandatory fuel-switching. Under the Energy Supply and Environmental Coordination Act of 1974[4] (ESECA) and amendments adopted by the energy conference committee in November, 1977, certain major fuel-burning installations are prohibited from using natural gas or petroleum as their primary energy source. The purpose is "to foster greater national energy self-sufficiency by requiring certain...installations...to use indigenous coal and other fuel resources in lieu of natural gas or petroleum.[5]

ESECA would seem to have significant potential for increasing the demand for coal, but, after three years on the books, it has actually induced very little fuel switching.[6] Even though coal prices have fallen while oil prices have risen (during 1974-1977), oil-fired power plants can still be cheaper to own and operate than coal-fired facilities. In these cases, utilities have gone to court to oppose conversion orders.

Opposition has also come from other federal agencies. For example, at the request of the EPA the Federal Energy

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[1] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 685.

[2] Krohm, G.C., C.D. Dux, and J.S. Van Kuiken. Effect on Regional Coal Markets of the "Best Available Control Technology" Policy for Sulfur Emission, National Coal Utilization Assessment. Argonne, Ill.: Argonne National Laboratory, 1977.

[3] See Chapter 6 on air quality for an expanded explanation of this uncertainty.

[4] Energy Supply and Environmental Coordination Act, Pub. L. 93-319, 88 Stat. 246, as amended by Pub. L. 94-163, 89 Stat. 871.

[5] Quoted in "Energy Act Coal Conversion Proposals: A Summary." Coal Industry News, Vol. 1 (December 12, 1977), p. 5. Note also that synthetic gas from coal can be used in power plants.

[6] Rowe, James L., Jr. "Conversion to Coal Still is Mostly Talk." Washington Post, June 19, 1977, pp. L1, L6.

Administration (FEA)[1] deleted 23 power plants from its list of 54 slated for mandatory conversion to coal.[2] EPA said that conversion of those power plants "would conflict with the national commitment to protect and improve the environment and, therefore would be inconsistent with the purposes of ESECA." Until such differences of opinion are resolved and a firm policy established, coal and uranium producers will continue to face demand uncertainty related to fuel-switching.

(3) Government and Institutional Uncertainties

Even if an energy development is technically feasible and economically sound, it still faces several governmental and institutional barriers to being brought on-line. One of these barriers is simply the number of regulatory approvals that must be sought. For example, Southern California Edison and its partners spent thirteen years and $22 million in acquiring water rights and preparing an environmental impact statement for the Kaiparowits project. At that point they still needed 220 more authorizations from 42 agencies.[3] Interests opposed to development tend to favor complicated procedures because (a) it gives them more time to prepare their case and more opportunities to publicize it; (b) the larger the number of approvals required, the greater the chance of a permit denial; and (c) mounting costs may induce the developer to abandon a project. The Environmental Defense Fund's energy specialist has remarked, "Delaying is often the answer. You tie up the economic investment of a company, and they finally do something else."[4] His position is sound since delay is expensive. For example, if a billion dollar project is half completed, each month's delay adds $4 million in interest cost, and a year's delay amounts to $50 million.[5]

Many of the governmental uncertainties in western energy development occur at the state level, especially with regard to state policies on water allocation, land reclamation requirements, taxation, and impact mitigation requirements.[1] As noted in Chapters 2 and 12, officials in some western states are expressing concern that the West is being viewed as an "energy colony" for the rest of the country. While by no means a consensus position, this concern and proposals for dealing with it, such as possible federal energy-impact assistance, do contribute to the uncertainty with which investors and developers must deal. For example, the boomtown effects of energy development can be quite severe, as discussed in Chapters 8 and 9. Many of the alternatives for dealing with these effects call for either direct or indirect assistance from developers. Until the nature and extent of the developers' responsibility is established, investors and developers will not know what the effect will be on the cost of development.[2]

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[1] The program is now administered by the Economic Regulatory Administration within DOE.

[2] Bureau of National Affairs. "New England Utilities to Challenge FEA Conversion Order in Federal Court." Energy Users Report, Current Report No. 194 (April 18, 1977), pp. 9-11.

[3] Myhra, David. "Fossil Projects Need Siting Help Too." Public Utilities Fortnightly, Vol. 99 (September 29, 1977), pp. 24-28.

[4] Ibid., p. 26.

[5] At an annual interest rate of ten percent.

An area of state policy with a direct economic effect on energy development is state severance taxes on energy minerals. A quantitative indication of the impact of state severance taxes on developers is indicated in Table 10-5. There is considerable variation among states, with Utah having the lowest rates for each of the minerals tabulated here. The highest rate for gas, oil, or uranium is 5.5 percent, seemingly not enough to greatly affect the economic viability of many mines.[3] Rates on coal have moved much higher, particularly in the Northern Great Plains states. Uncertainty is introduced by the rapid rate of change in state law. For example, of the eighteen severance tax rates listed in Table 10-5, nine were changed during the 1977 legislative session.

The perception of taxes by developers on the one hand and by state and local governments on the other, may diverge considerably. In most cases, revenues would seem to look bigger to the local government than the cost does to the developer. That is, the proportional impact on developers and their ultimate customers is not as great as on the units of government receiving the revenues.

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[1] Chapters 4 (Water Availability), 7 (Land Use), and 9 (Growth Management) discuss the problems and issues in these areas.

[2] Gilmore, John S. "Boom Towns May Hinder Energy Resource Development." Science, Vol. 191 (February 13, 1976), pp. 535-40; Jacobsen, Larry G. "Coping with Growth in the Modern Boom Town." Personnel Journal, Vol. 55 (June 1976), pp. 288-89, 303; and Chapters 8 and 9 of this report focus on housing and growth management problems and issues. See also U.S., Energy Research and Development Administration. Assistance from Energy Developers: A Negotiating Guide for Communities. Washington, D.C.: Energy Research and Development Administration, Office of Planning, Analysis, and Evaluation, 1977.

[3] Note, however, that in most cases property and other taxes are applied in addition to severance taxes.

TABLE 10-5: STATE MINERAL SEVERANCE TAXES
(percent)

STATE	COAL[a]	GAS AND OIL	URANIUM
Colorado	7.2[b]	5.0[c]	2.5[c]
Montana	30.0	2.65	–[d]
New Mexico	4.6[b]	4.9[b,e]	5.0[b]
North Dakota	11.3[b]	5.0[c]	–[d]
Utah	0.0	2.0	1.0
Wyoming	10.5[f]	4.0	5.5

[a] Surface-mined.

[b] Law written in cents per unit. Values of resources assumed here of: $8.33/ton for coal in Four Corners States, $5.73/ton for coal in Northern Great Plains, $1.45/thousand cubic feet for gas, $9.15/barrel for oil, $40/lb. for uranium (yellowcake).

[c] Before property tax credits.

[d] No taxable production in 1977.

[e] 3.4 percent effective rate for gas.

[f] Reverts to 8.5 percent after the 2 percent special levy has accumulated to $160 million (probably around 1993).

Source: Bronder, Leonard D. Severance Tax Comparisons Among WGREPO States, Staff Analysis No. 77-28. Denver, Colo.: Western Governors' Regional Energy Policy Office, June 1977.

Consider, for example, Montana's 30 percent severance tax. Since transportation can triple the cost of coal at the destination as compared to the mine-mouth cost, such taxes represent about 10 percent of the delivered price. But if, as projected in the SRI Low Demand Case, Montana is producing 525 million tons per year by 2000, the severance tax will yield more than $1.5 billion per year. By comparison, the state government's revenues from all sources in recent years have been only about $700 million (fiscal 1973).

The producing states view taxation as an effective way of achieving several objectives, including repairing and compensating for social and physical damages. Developers and out-of-state consumers might be expected to tolerate energy taxes for such purposes, but may protest vigorously when they see coal revenues virtually financing whole state governments. In fact, 53.5 percent of Montana's severance tax (after 1979) is allocated to general government purposes such as education; 35 percent is specifically earmarked for mitigating coal development impacts. The remainder goes to such things as parks acquisition, research on energy alternatives, and renewable resource development. The justification for this 11-1/2 percent seems to be based on the belief that Montana should start building economic alternatives against the day when the coal runs out. In the words of the state budget director, "With the tax money in the bank, we can ride out the kind of economic catastrophes the copper companies used to threaten us with if they didn't get their way."[1] But out-of-staters are beginning to feel that "the emerging pattern of state coal tax policy in the Northern Great Plains is one of OPEC-like revenue maximization."[2]

Uncertainty about governmental actions is even greater when a proposed development is on an Indian reservation. The Council of Energy Resource Tribes (CERT) represents 22 tribes who collectively own more than half of the uranium resources in the U.S. and 16 percent of the coal. CERT has been less shy than state governments about acquiring an "OPEC-like" reputation. Last year they went directly to OPEC for assistance in planning.[3] The increased aggressiveness of Indians has already resulted in renegotiation of coal leases which had originally been arranged by the

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[1] Quoted in Richards, Bill. "Boom in Strip Mining: Windfall for Montana." Washington Post, May 22, 1977, pp. A1, A4.

[2] Nehring, Richard, and Benjamin Zycher. Coal Development and Government Regulation in the Northern Great Plains. Santa Monica, Calif.: The Rand Corporation, 1976, p. 148.

[3] Fialka, John. "The Navajo Nation." Washington Star, October 23, 1977.

Bureau of Indian Affairs (BIA) in the 1950's and 1960's. For example, the Crow Tribe in Montana has received a proposal for $1.35/ton royalty from AMAX, Inc. compared to 17.5 cent royalties which had been common for Indian resources as late as 1974.[1] The Crow may also collect some revenues which would otherwise go to the states. Recently they requested and received a favorable ruling from the Interior Department to the effect that states cannot tax Indian coal. Shell Oil has responded by offering a 38 percent royalty if Montana's 30 percent tax is actually avoided.[2]

Both state and Indian fiscal actions raise legal issues which might not be resolved very quickly. The Interior Department's ruling on Indian coal, for example, may go through a long series of appeals. Severance and conversion taxes have prompted litigation on constitutional grounds. When almost all of a commodity produced in a state is exported from that state, taxation of it could be considered a restraint of interstate commerce, which is prohibited by the federal constitution. Several utilities have challenged New Mexico's electricity generation tax on such grounds.[3]

B. Responses to Risk

Energy developers and financial institutions have developed various strategies to deal with the uncertainties described above. In fact, much of the traditional behavior of electric and gas utilities has been oriented towards reducing risk. Electric utilities, especially, have received a legal mandate to provide "all the power demanded at all times to all comers."[4] This fact has led to several distinctive industry features, including an expansionist attitude that growth is necessary, proper, and inevitable,[5] and backward vertical integration, i.e., utilities acquiring ownership of their supply sources, such as mines, trains, and storage facilities. The Tennessee Valley Authority, for example, has acquired uranium properties in Wyoming to be assured of a fuel supply for its nuclear power plants.

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[1] Crittenden, Ann. "Coal: The Last Chance for the Crow." New York Times, January 8, 1978, Section 3, p. 11.

[2] "U.S. Indians Demand a Better Energy Deal." Business Week, December 19, 1977, p. 53.

[3] "N.M. Court Weighs Electricity Tax Suit." Denver Post, November 12, 1977.

[4] Maher, Ellen. "The Dynamics of Growth in the U.S. Electric Power Industry," in Sayre, Kenneth, ed. Values in the Electric Power Industry. South Bend, Ind.: University of Notre Dame Press, 1977, p. 189.

[5] *Ibid.*

The concern with assured supply has also led to long-term fuel contracts and power-pooling among utilities within a region. Virtually all of the electric utilities in the West have been interconnected via the Western Systems Coordinating Council, a voluntary group at least implicitly encouraged by the Economic Regulatory Administration (ERA).[1] Similar pools have been established to cover most of North America. The regional councils are further grouped into a National Electric Reliability Council.

Gas utilities have also emphasized reliability of service, although not quite to the same extent as electric utilities. Pipeline companies have usually sought assurances on both ends that their lines would be fully utilized well into the future. Specifically, they have required reserves to be dedicated to them by producers, thereby assuring supply, and they have insisted on long-term "take or pay" contracts from distributing companies.[2] Oil pipelines, too, have rules which enable them to keep their lines full at all times.[3] The advent of coal gasification will heighten the utilities' risks. (As can be seen in Table 10-6, most of the synthetic fuels plants proposed to date are of the gasification type.) In contrast with the current system of many small natural gas producers feeding into each interstate pipeline, each SNG plant would be very large (on the order of 250 billion cubic feet/day). And, as noted earlier, the required investment would just about equal the total assets of an entire gas company.[4]

Financial institutions have started to fund selected projects which, according to traditional financial balance sheet analysis, would not be considered creditworthy for investors. In a related trend, a developer's arrangements with financial institutions and other parties are involving many investors, with banking specialists often coordinating them (see box entitled "Challenging Assignment").

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[1] Breyer, Stephen, and Paul MacAvoy. Energy Regulation by the Federal Power Commission. Washington, D.C.: Brookings Institution, 1974, pp. 112-13.

[2] Ibid., pp. 5-6. Take or pay contracts require the buyer to pay a specified amount whether or not he has enough storage capacity to accept delivery during slack periods.

[3] Pipeline Demurrage and Minimum Shipment Rule on Propane, 315 I.C.C. 443 (1962).

[4] The land, plant, and equipment of the eight gas companies identified in Table 10-3 averages $1.69 billion. Source: Moody's Utilities, 1977.

TABLE 10-6: PLANNED WESTERN SYNFUEL PROJECTS

OWNER	FACILITY	LOCATION
American Natural Gas Co.	250 MMcfd SNG	North Dakota
American Natural Resource Co. and Peoples Gas Co.	125 MMcfd SNG	Beulah, North Dakota
Burlington-Northern	.365 MMtpy to "fuel"	Circle, Montana
Cities Service and Northern Natural Gas	250 MMcfd SNG	Powder River, Wyoming
Gulf Oil Corp. and Standard Oil Co. of Indiana	50 Mbbl/day Shale Oil	Rangely, Colorado
Mintech Corporation (Camaron Engineers)	10 MMtpy to SNG	Watkins, Colorado
Natural Gas Pipeline Co. of America	250 MMcfd SNG	Dunn County, North Dakota
Occidental Oil Shale, Inc.	57,000 bbl/day shale oil	Rio Blanco County, Colorado
Panhandle Eastern Pipeline	250 MMcfd Lurgi	Rochell, Wyoming
Peoples Gas Co.	4 SNG plants	North Dakota
Rio Blanco	Shale Oil	Rangely, Colorado
Southern California and Texas Eastern	250 MMcfd SNG	Farmington, New Mexico

MMcfd = million cubic feet per day
SNG = synthetic natural gas
MMtpy = million tons per year

Mbbl/day = thousand barrels per day
bbl/day = barrels per day

Sources: "Related Fuels--Worldwide Construction." Oil and Gas Journal, Vol. 75 (April 25, 1977), p. 183; and "Related Fuels--Worldwide Construction." Oil and Gas Journal, Vol. 76 (April 24, 1978), p. 153; Nielsen, George F. "Coal Mine Development and Expansion Survey... 617.3 Million Tons of New Capacity 1977 through 1985." Coal Age, Vol. 82 (February 1977), p. 88.

CHALLENGING ASSIGNMENT FOR INVESTMENT BANKER

The Alcan gas pipeline from Prudhoe Bay to the lower 48 states promises to be "the most expensive and complicated single project that the U.S. capital markets have ever had to finance." Its estimated cost ($13 billion) is half as large as the total assets of the dozen gas transmission companies involved, whereas the oil companies which built the Alyeska pipeline had assets 13 times as large as the project cost. Moreover, President Carter has strictly ruled out government guarantees.

Probable U.S. participants include:

First Boston Corporation investment bankers heading up the financial arrangements
Loeb Rhoades and Company investment advisors
12 gas transmission companies, as owners/operators of 4 legally independent segments of the project
Exxon, ARCO, and BP-Sohio, the gas producers, who are likely to guarantee some of the debt.
Federal Energy Regulatory Commission, which will determine the gas's selling price
A 5-agency federal executive policy board to expedite permitting procedures
Bank of America, leading a consortium of banks in short-term financing
Massachusetts Mutual Life Insurance, and numerous other insurance companies, buying long-term bonds.
The State of Alaska, beneficiary of taxes and royalties, which may guarantee some of the debt
Pacific Gas Transmission and Pacific Gas and Electric, owner/operators of the West Coast leg, handling financing on their own

--"Financing: The Real Test for Alcan Pipeline." Business Week, November 28, 1977, pp. 102-4.

Lenders also have moved increasingly toward project financing, whereby assurance is sought that a particular project has a good chance of success.[1] This success is measured by the actual cash flow generated from an energy project as a source of repayment rather than from the strength of the firms involved.[1] Hence, a reliance has evolved on long-term contracts, utility-owned railroad cars, and other devices that assure that a project is financially sound in itself.

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[1] Wilson, Wallace W. "Capital for Coal Mine Development." Coal Mining and Processing, Vol. 13 (January 1976), pp. 68-70. This is especially the case for coal mine projects, largely in response to fluctuations in the coal industry which have resulted in the average rate of return on capital staying 2.5 percentage points below other mineral industries since 1971. See Tomimatsu, Tommy, and Robert E. Johnson. The State of the U.S. Coal Industry: A Financial Analysis of Selected Coal Producing Companies with Observations on Industry Structure, Bureau of Mines Information Circular 8707. Washington, D.C.: U.S., Department of the Interior, Bureau of Mines, 1976, Table 9.

In its reliance on real assets, project financing is akin to a mortgage, but the lenders' share in the commercial risks remains, since the debt is repaid only if, as, and when the coal is mined. The approach, which originated in the oil industry, has become common throughout other energy industries.

Electric utilities also have been trying to find ways of stretching their borrowing power. As a result of rapid growth in what is the most capital intensive industry of all,[2] electric companies are relying on external sources (securities markets) for a steadily increasing share of their construction capital. Another consequence of large and lengthy construction projects is that $40 billion is now tied up in unfinished facilities--equivalent to 18 percent of all electric plant investment in the U.S. Traditionally, utilities have increased their borrowing to pay the interest on construction work in progress (CWIP), putting further strains on their creditworthiness. Recently, however, many state utility commissions have allowed the customers to be charged immediately for interest on CWIP. The rate-payers are in effect made into investors, but the utility is enabled to reduce its borrowing--legally defined--by just that amount. The device has been challenged before many state utility commissions, and it is not yet a common practice.[3]

A recent proposal for stimulating coal gasification financing uses a similar method. DOE is recommending to the FERC that the first commercial coal gasification project in the U.S. in Mercer County, North Dakota be guaranteed by increases in customer rates if the plant should fail. In other words, consumers rather than investors, would bear the risk through an "all events tariff" on gas bills. The Federal Power Commission (FPC), FERC's predecessor, historically disapproved of the practice of requiring customers to guarantee utility projects, but DOE feels this arrangement is needed to get synfuels projects started.[1]

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[1] Vickers, Edward L. "Comments on Project Financing," in U.S., Department of the Interior, Bureau of Land Management. Southwest Energy-Minerals Conference Proceedings. Santa Fe, N. Mex.: Bureau of Land Management, 1977, Vol. 1, p. 217.

[2] Electric utilities currently have an average of $3.50 invested in plant and equipment for each $1.00 of annual revenue. This compares with less than $1.00 for the steel industry and 55¢ for the auto industry.

[3] For both favorable and critical views, see Corey, Gordon. "Further Observations on the Taxation of Regulated Utilities." Public Utilities Fortnightly, Vol. 100 (November 10, 1977), pp. 16-18; and Newburger, David. "Electric Power--Who Pays for Expansion?" Environment, Vol. 19 (June 1977), pp. 50-52.

C. Energy Market Competitiveness

Increasing amounts of capital have been invested in western energy development by large diversified energy firms. Exxon, Gulf, and Kerr-McGee are among the largest owners of domestic coal and uranium reserves, including substantial portions of these resources located in the West. In addition to oil companies, firms traditionally powerful in the West, such as Burlington Northern and Union Pacific Railroads, are now developing energy resources, or have merged with energy companies, as Anaconda Copper has with ARCO. While this trend is bringing to the West unprecedented sources of capital, technical expertise, and marketing channels, it also brings the danger of excessively concentrated economic power. It is possible that oil companies are acquiring mineral rights and process patent rights simply in order to preempt potential sources of competition. Of 24 petroleum companies with major coal reserves, only 8 have mined any of it.[2] Oil company entry into other fields may thus lead to less production than if they were kept out of those fields.

Concentration of ownership can occur at several levels: mineral resources, production facilities, patents, and federal leases. Adverse consequences of any of these types of concentration could include restricted production, higher prices, a slower rate of innovation, or domination of state and local governments (see box entitled "State Lobbyists"). The diversified energy firms which have been entering western energy production maintain that their participation is needed. A recent Bureau of Mines study agreed with that point of view, stating that the emerging trend should strengthen coal's financial structure and aid its position in the new capital market. Furthermore, a parent or controlling company with a coal subsidiary or affiliate can readily shift capital funds according to program needs.[1] Conflict, then, has arisen between the major oil companies who claim they are the only ones with enough capital and expertise to do the job and some consumer-oriented groups who fear that the majors are simply nipping competition in the bud.

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[1] "How to Finance Gas Produced From Coal." Business Week, June 19, 1978, pp. 33-36.

[2] Federal Trade Commission survey noted in Greider, William. "U.S. Oil Industry Stakes Out Role for the Future." Washington Post, May 22, 1977, pp. A1, A6.

Since the passage of the Sherman Act in 1890 it has been a national policy to promote competition by preserving a large number and variety of decisionmaking units in the economy.[2] The first landmark action taken under the antitrust laws, Standard Oil Co. v. U.S.,[3] which broke up the Standard Oil Trust, was only the beginning of a long series of enforcement actions since "in time the resulting segments grew and became more powerful than the original company."[4] In fact, a 1940 suit--perhaps the most ambitious undertaking ever by the Justice Department's Antitrust Division--was called the Mother Hubbard case, because it covered everything. The American Petroleum Institute, the major oil companies and their affiliates were charged with every conceivable form of an anticompetitive conduct.[5]

STATE LOBBYISTS

"They're slick," says Wyoming state senator Roger McDaniel of energy company lobbyists. "We've had them in here from New York, Los Angeles,....and all over....Some of them are a little intimidating for a part-time legislator."

Governor Herschler in an interview in June 1977, related that in the past, "...everyone knew everyone else's business and that kept things under control. Now we're dealing with new people and huge amounts of money. I know that somewhere down the road someone's going to get caught with their hand in the till."

--Washington Post, June 26, 1977.

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[1] Tomimatsu, Tommy, and Robert E. Johnson. The State of the U.S. Coal Industry: A Financial Analysis of Selected Coal Producing Companies with Observations on Industry Structure, Bureau of Mines Information Circular 8707. Washington, D.C.: U.S., Department of the Interior, Bureau of Mines, 1976, p. 11.

[2] "Special Project--The Energy Crisis: The Need for Antitrust Action and Federal Regulation." Vanderbilt Law Review, Vol. 24 (May 1971), pp. 724-25.

[3] Standard Oil Co. v. U.S., 221 U.S. 1 (1911).

[4] U.S., Congress, Senate, Committee on the Judiciary. Petroleum, the Antitrust Laws and Government Policies. S. Report 1147, Serial 11979, 85th Cong., 1st sess., 1957.

[5] U.S., Congress, House, Select Committee on Small Business. Anticompetitive Impact of Oil Company Ownership of Petroleum Product Pipelines. Hearings before the Subcommittee on Special Small Business Problems, 92d Cong., 2d sess., June 13-15, 1972.

The major oil firms have grown very large and profitable compared to any other industry; in fact, ten of the twenty largest industrial corporations in the country are oil and gas companies. The firms in this industry among Fortune's 500 listing gave investors a compound rate of return of 13.5 percent per year over the period 1966-1976, higher than any other industry.[1] A more salient determinant of whether markets will be competitive, however, is firm size relative to industry size. In this regard, the oil industry is less concentrated than the average manufacturing industry. The four largest firms in the typical manufacturing industry account for roughly 40 percent of production.[2] Four-firm ratios (the share of the market accounted for by the four largest firms) in the petroleum industry as of 1974 were somewhat lower, ranging from 26.0 to 35.1 percent at various stages of processing.[3]

Certain other features of the energy industry tend to increase the influence of the large companies more than suggested by the foregoing figures:

- The top firms at one stage of processing, such as crude production, tend to be the same firms which lead the other stages, such as marketing. There are only about 20 such "vertically integrated" firms, accounting for 58 to 94 percent of processing at various stages.
- The majors "do not function as independent or competitive, but as cooperative entities at every strategic point of the industry's integrated structure."[4] They cooperate in joint ventures for bidding on offshore leases, building pipelines, developing foreign reserves, and other projects. Joint ventures "establish a community of interest among the parents and a mechanism for avoiding competition between them."[5]

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[1] "The Fortune Directory of the 500 Largest U.S. Industrial Corporations." Fortune, Vol. 95 (May 1977), p. 66.

[2] Scherer, F.M. Industrial Market Structure and Economic Performance. Chicago, Ill.: Rand McNally, 1970, p. 63.

[3] Markham, Jesse. "Market Structure and Horizontal Divestiture of the Energy Companies," in Moore, W.S. Horizontal Divestiture. Washington, D.C.: American Enterprise Institute for Public Policy Research, 1977, p. 17.

[4] Adams, Walter. "Horizontal Divestiture in the Petroleum Industry: An Affirmative Case," in Moore, Horizontal Divestiture, p. 7.

[5] Ibid.

- The oil companies have been diversifying into other energy resources.

This last trend, "horizontal" diversification, bears most directly on the western region. Oil and gas are expected to be superseded by coal, uranium, and oil shale as the major western energy resources, and the integrated energy companies have already acquired the largest single share of reserves of these energy materials.[1] As shown in Table 10-7, oil and gas companies own 41.1 percent of the nation's privately held coal reserves. In western operations, independent coal companies have become the exception rather than the rule. Similar penetration by oil and gas firms has occurred in the uranium industry, where 10 out of the 20 largest holders of reserves are oil and gas companies.[2]

Federal leasing policy will have a direct influence on the competitiveness of western energy markets. Although federal coal until recently accounted for only 1 percent of national production, almost 80 percent of western reserves are federally owned or lie under or adjacent to federal lands. The federal leases which have been granted to date have resulted in a greater concentration of control than for the coal industry as a whole, and especially in subregional market areas. In Utah, Arizona, and New Mexico, which tend to serve markets to the west, four firms (Peabody, Arizona Public Service, El Paso Natural Gas, and Continental Oil) hold 43.6 percent of the leased acreage.[3] In the Wyoming, Montana, North Dakota area, which tends to serve markets to the south and east, four groups (Pacific Power & Light, Peabody, Richard D. Bass Petroleum, and Exxon) hold 34.8 percent of the leased acreage.

Production on the federal leases has been nonexistent or, at most, leisurely, suggesting the possibility that they were obtained for speculative purposes. Of the 16.4 billion tons under lease in the eight-state region, only 32.6 million tons were mined during 1976. Even if production grew by more than 20 percent per year until full capacity were reached, it would take 40 years to

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[1] The one major exception to the decline of oil and gas is in western Wyoming, where recent discoveries are likely to yield the best fields since Alaska's Prudhoe Bay. Ratner, Steven. "Geologically Weird 'Overthrust Belt' Excites Oil Drillers." New York Times, December 27, 1976, p. D1.

[2] Greider, William. "U.S. Oil Industry Stakes Out Role for the Future." Washington Post, May 22, 1977, p. A16.

[3] Bierman, Sheldon L., et al. Innovation versus Monopoly: Geothermal Energy in the West, Final Report, Report No. DGE/3036-1. Washington, D.C.: U.S., Energy Research and Development Administration, Division of Geothermal Energy, July 1977, Table 52.

TABLE 10-7: COAL RESERVES OF INDUSTRIAL GROUPS, 1976 (millions of tons)

GROUP	RESERVES
Oil and Gas	
Continental (Consolidation)	13,700
Exxon (Monterey, Carter)	8,400
El Paso Natural Gas	5,200
Occidental (Island Creek)	3,570
Gulf (Pittsburg and Midway)	2,750
Mobil	2,500
Sun	2,200
ARCO	2,200
Phillips	2,000
Tenneco	1,700
Other	10,880
	55,100
Railroads	
Burlington-Northern	11,400
Union Pacific	10,000
Other	1,990
	23,390
Metals	
Newmont *et al*. (Peabody)	8,900
AMAX[a]	5,040
U.S. Steel	3,000
Bethlehem Steel	1,800
Other	3,200
	21,940
Independent Coal	
North American	5,100
Westmoreland	1,950
Pittston	1,700
Other	6,860
	15,610
Utilities	
Pacific Power and Light	1,700
Other	4,720
	6,420
Other Industries	11,790
All Identified Reserves	134,250

Source: National Coal Association. *Implications of Investments in the Coal Industry by Firms From Other Energy Industries*. Washington, D.C.: National Coal Association, 1977, Appendices B and H.

[a] AMAX might also be classified with oil and gas, as it is 21 percent owned by Standard Oil of California.

mine the coal already under lease.[1] Moreover, a Bureau of Land Management (BLM) study found that owners of leases covering 60 percent of these reserves have never produced and have not indicated any plans for production before 1990.[2] The average age of these leases is already 11 years. A Federal Trade Commission (FTC) staff report on the 20 largest federal lessees identified seven that were not producing; five of the seven lessees are oil companies.[3]

In recognition of the federal government's growing role in the coal industry, various measures have been adopted to make sure that this role promotes a competitive market. A traditional policy in minerals leasing has been the requirement of "diligent development."[4] Under current regulations, mining plans "must provide for the mining of all the reserves of the logical mining unit of which the lease is a part in a period of not more than 40 years."[5] One of the purposes of diligent development is to discourage private companies from holding reserves indefinitely in anticipation of future price rises or, worse, from causing price rises by withholding production. The Secretary of the Interior also is required to consult with the Attorney General regarding the effect on competition of all proposed leases.

However, such measures may be inadequate. In regard to leases issued before the current moratorium, Interior has never cancelled a lease for failure to maintain diligent development.[6] As for other incentives, such as a $4 per acre annual rental if no production is underway, "it is doubtful that rentals of this magnitude would have a significant effect in stimulating production."[1] The other approach mentioned above, antitrust review of leases, calls for very subjective judgments.

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[1] Raleigh, W.A. "Mediation Research Aims to Unlock Federal Coal Leasing Program." Coal Industry News, Vol. 2 (January 23, 1978), p. 11.

[2] Quoted in Bierman, Sheldon L., et al. Innovation versus Monopoly: Geothermal Energy in the West, Final Report, Report No. DGE/3036-1. Washington, D.C.: U.S., Energy Research and Development Administration, Division of Geothermal Energy, July 1977, p. 499.

[3] Ibid., p. 500.

[4] Mineral Leasing Act of 1920, Pub. L. 66-146, 41 Stat. 437, 30 U.S.C.A. 207.

[5] 30 C.F.R. 211.10(c)(6)(ii).

[6] U.S., Congress, House, Committee on Interior and Insular Affairs. Federal Coal Leasing. Hearings before the Subcommittee on Mines and Mining, 93d Cong., 2d sess., July 25-August 15, 1974.

The Peabody Coal case illustrates the difficulties in this field.[2] The FTC opposed the 1968 merger of Peabody Coal (the nation's largest) with Kennecott Copper (the nation's largest in that industry). It was argued that the merger eliminated Kennecott as a potential competitor who might otherwise have entered the industry on its own. The final arrangement which the FTC accepted, however, could be questioned on the same grounds: the leaders of the purchasing group were Newmont Mining and the Williams Companies. Newmont is the fourth largest copper producer and owns substantial stock in the 2nd and 10th leading coal producers; Williams has extensive oil and gas interests, especially oil pipelines. At the same time, other copper/energy combinations have been left standing, namely Anaconda with ARCO, and AMAX with Standard Oil of California.

Federal legislation to divide energy companies or keep them out of new fields generally has not been been successful. Senators Hart (D-MI) and Abourezk (D-SD) offered an amendment to an emergency natural gas act (S. 2310) which mandated "vertical divestiture." That is, major oil and gas companies would have to choose only one of the four phases--production, transportation, refining, and marketing--and leave the others. The measure failed the Senate in October 1975 by only nine votes, and a similar measure (S. 2387) passed the Senate Judiciary Committee in June 1976 but failed to reach the floor. Questions concerning competition in the energy industry will continue to be raised in the context of western energy development.

10.2.3 Summary

A number of risks and uncertainties in western energy development potentially limit the availability of capital for development at the scale projected in our scenarios. These risks arise from technical, economic, and governmental and institutional factors. In addition, diversified energy companies have acquired large holdings of energy resources in the West, raising fears that these firms are closing off potential competition from new energy forms.

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[1] U.S., Congress, Senate, Committee on Interior and Insular Affairs. Report to the Federal Trade Commission on Federal Energy Land Policy: Efficiency, Revenue, and Competition, Committee Print, by the Federal Trade Commission, Bureau of Competition and Economics. Washington, D.C.: Government Printing Office, 1976.

[2] Shifrin, Carole. "Debate Continuing on Peabody Coal Decision." Washington Post, August 14, 1977, pp. L1, L3.

- Technical factors that add to financial risk include: unknown performance for new technologies at commercial scales, relatively low investment in R&D by the energy industry, and large capital investments required for commercial-size plants.

- Economic factors include: the world energy market and its effect on the economic viability of advanced energy technologies, and federal policies concerning energy pricing. In addition, uncertainty over federal clean air and fuel-switching policies makes demand for western coal and investment in western energy development relatively risky.

- Governmental and institutional uncertainties that contribute to financial risk include: the large number of regulatory and administrative approvals required for energy facilities, particularly at the state level; the imposition of severance taxes on energy minerals; and the degree of control which Indian tribes might have on energy development. These factors add to the time or cost of energy development, thereby increasing financial risk to investors.

- Major oil companies are acquiring large holdings of coal, oil shale, and uranium reserves in the West, and little if any production has taken place. This has brought accusations that the large firms are trying to close off competition from other energy resources. The firms themselves hold the opposite view, claiming that only large, diversified firms have enough capital and expertise with energy to do the job.

In sum, although western energy development overall would not be constrained by national capital availability, individual energy projects will be subject to a number of uncertainties that threaten secure investment. The problem for one particular facility will tend to spread to other facilities since financing tends to follow areas of proven success. The problems evident for individual facilities can have a broader influence on the capital available for western energy development generally.

10.3 ALTERNATIVE POLICIES FOR CAPITAL AVAILABILITY

10.3.1 Introduction

Given the uncertainties surrounding large energy development ventures in the western U.S. (and elsewhere), financial risks will often be greater than for other investment opportunities,

TABLE 10-8: CAPITAL AVAILABILITY POLICY ALTERNATIVES

OBJECTIVE	CATEGORIES OF ALTERNATIVES	SPECIFIC ALTERNATIVES
Assure adequate capital for western energy resource development	Provide financial subsidies to developers	Tax preferences Price guarantees
	Improve regulatory environment	Expedite siting process Deregulate oil and gas prices Permit "rolled-in" prices for synthetic fuels
	Promote new sources for investment	Encourage new participants by improving leasing system Consumer risk assumption for new energy projects

thereby raising the cost of obtaining financial backing. The policy objective on which this section is based is to assure the availability of investment capital for western energy development. To meet this goal, these categories for policy alternatives are identified:

- Provide financial subsidies to developers;
- Improve the regulatory environment;
- Promote new sources of investment.

There are several specific alternatives within each of these categories (see Table 10-8). For example, financial subsidies could be provided either through tax incentives or price guarantees in order to encourage investment in new, risky energy technologies. Regulatory changes could produce greater certainty about pricing and permitting associated with western energy facilities. The price regulation/deregulation options differ from subsidies in that the energy market would determine the actual price level, in contrast to a price "floor" supported by the government regardless of market forces. Both approaches could reduce risks

TABLE 10-9: FINANCIAL SUBSIDIES

SPECIFIC ALTERNATIVE	IMPLEMENTATION STRATEGY	CONSTRAINTS
Tax preferences	Investment tax credit, accelerated depreciation, or tax exempt bonds for energy facilities	Reduction of government revenues; administrative burden on IRS
Price guarantees	Price floors for certain synthetic plants set by DOE	Could require substantial government expenditures

IRS = Internal Revenue Service
DOE = Department of Energy

to investors by eliminating uncertainty over future energy prices.[1] The time-consuming energy facility siting and permitting process is responsible for a large share of the cost and risk associated with new energy facilities. An expedited permit process would shorten the time involved, thereby reducing the financial risks and the interest cost of a project.

The second category of alternatives, promoting new sources of investment, would bring different participants into the financing of western energy development. Increased consumer rates to help pay for new facilities and streamlined energy resource leasing systems could, along with other results, increase the amount of investment in western energy development. The following section describes the policy alternatives listed in Table 10-8 in more detail.

10.3.2 Description of Alternatives

A. Financial Subsidies

Table 10-9 lists the specific alternatives considered in this category, along with possible implementation strategies and potential constraints for each specific alternative. One specific alternative is to institute tax preferences for energy development, such as a larger investment tax credit, accelerated depreciation, or tax exempt status for energy facility bonds. All would need to be included in tax code changes, which would require Congressional action. The Internal Revenue Service (IRS) already administers thousands of tax preferences, some designed to promote equity, some as incentives for a wide range of activities. The ones with the largest current impact on energy investment are: the investment tax credit, percentage depletion, accelerated depreciation, and special treatment of intangible development costs.[1] Tax exemption for bonds is another tax preference measure that has been granted to help finance pollution control equipment but not, as yet, energy facilities generally.

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[1] The situation is more complicated for coal gasification plants, whose feasibility is affected by the ability to utilize existing pipeline infrastructure. This requires a decision whether to roll in the synthetic gas price with that of natural gas currently committed to the pipeline.

The investment tax credit will be given particular attention in the evaluation section. As currently in effect, this provision of law allows businesses to reduce their tax liability by 10 percent of their expenditures on new equipment. Recent proposals have focused on several potential modifications of the credit:[2] (a) increasing the rate, (b) making the rate permanent (it is scheduled to revert to 7 percent eventually), (c) increasing the rate for certain industries, (d) extending the credit to buildings as well as equipment, and (e) allowing a company to offset up to 90 percent of its tax liability with the credit (compared with 50 percent now). The evaluation below will concentrate on an alternative such as (c): increasing the credit for domestic energy production investments.

Price guarantees, the other specific alternative considered in the financial subsidies category, would support the development of synthetic fuel and other advanced energy technologies by setting a floor price for the product. In the case of synthetic gas and shale oil, the guaranteed price required could be as much as 50 percent above the market price of gas and oil. The purpose of guarantees is to assure that new technologies are proven at a commercial scale and that sufficient experience takes place to allow improvements and refinements in the technologies. Price guarantees would probably be more narrowly targeted than tax preferences, and would be administered by the DOE rather than IRS.

Guarantees resemble tax preferences in that actual government expenditure depends on the response of the private sector.

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[1] Brannon, Gerard. "Existing Tax Differentials and Subsidies Relating to the Energy Industries," in Brannon, Gerard, ed. Studies in Energy Tax Policy, Papers Prepared for the Energy Policy Project of the Ford Foundation. Cambridge, Mass.: Ballinger, 1975.

[2] See, for example, Samuelson, Robert J. "Carter's Tax Tightrope." National Journal, Vol. 10 (January 28, 1978), p. 138.

The fiscal impact of tax preferences depends on how extensively firms take advantage of them, while the cost of guarantees is a function of the firm's costs, as well as market conditions. However, the two specific alternatives could differ markedly in ultimate expenditure and in the budgeting process. Guarantees differ from a fiscal point of view, in that whatever expenditures actually are made must be budgeted and go through the usual disbursement procedures. Tax preferences, on the other hand, are not budgeted expenditures, but reduce the income available in the government budget in an ex post way that is often difficult to predict.

B. Improve Regulatory Environment

The second category of alternatives considered is to improve the regulatory environment (see Table 10-10). The regulatory situation surrounding energy facilities affects the capital investment available for those ventures. Obtaining siting and other permits, for example, can result in significant delay in energy projects which means higher facility costs. Expediting the siting process, which is discussed in detail in Chapter 12, is one way of increasing the investment in western energy development.

Deregulation of oil and gas prices would provide an incentive for synthetic fuel facilities because the higher price that crude oil and natural gas would bring would allow synthetics to be more competitive. In contrast to price guarantees, deregulation would not involve government expenditure, although in both cases, higher costs would be borne by consumers or taxpayers. If prices were completely deregulated, the immediate effect would probably be a sudden price rise, followed by erratic prices as they adjusted to the market level. The role of OPEC in price stability (discussed in Section 12.2.2) would be greater in the case of deregulation.

The economic viability of shale oil and SNG also can be improved without price deregulation by rolled-in pricing for synthetic fuels that use existing pipelines. As discussed earlier, rolled-in pricing was common until 1972, although not in the context of coal gasification. If gasification is to become widespread as a substitute for increasingly expensive natural gas, rolled-in pricing is probably essential. Otherwise, users of synthetic gas would have markedly higher gas costs than those using traditional sources, reducing the potential market for coal gasification facilities.

As indicated in Section 10.2.2, the pricing alternatives considered here have a long history, and have been the subject of considerable political debate between producing and consuming states. The impact on western energy production is not often emphasized, but there is significant potential influence on the

TABLE 10-10: IMPROVE THE REGULATORY ENVIRONMENT

SPECIFIC ALTERNATIVE	IMPLEMENTATION STRATEGY	CONSTRAINTS
Expedite siting process (see Chapter 12)	"One-stop" siting process	Requires new state legislation
Deregulate oil and gas prices	Federal legislation removing price controls on oil and natural gas	Requires new federal legislation; opposition by consumer interest groups
Permit "rolled-in" prices for synthetic fuels	FERC to spread costs of synthetic fuels projects over all customers of certain pipelines	Previous FERC precedents

FERC = Federal Energy Regulatory Commission

feasibility and investment attractiveness of western coal and oil shale resources for synthetic fuels. Many of the synthetic fuel projects considered for the West (see Table 10-6) may be postponed or cancelled because of pricing issues.

C. Promote New Sources of Investment

New investment sources considered here include investors other than large firms and their financial backers. These new sources might be experimented with in selected situations, although none would be able to substitute completely for traditional participants in energy development. Two specific alternatives are considered in this category as summarized in Table 10-11.

One approach to broadening participation would be to streamline the procedures for transferring federal energy resources to the private sector. The system of distributing uranium resources, especially, can be characterized as chaotic and archaic. In this environment, competitive advantages may accrue to the larger firms who can employ staffs of geologists, lawyers, and claim investigators. Moreover, since the federal government itself does not

TABLE 10-11: PROMOTE NEW SOURCES OF INVESTMENT

SPECIFIC ALTERNATIVE	IMPLEMENTATION STRATEGY	CONSTRAINTS
Encourage new participants by improving leasing system	Put federally owned uranium resources under leasing system; streamline leasing system for other resources; set aside certain percentage for small companies	Changes in federal mineral leasing systems require Congressional action and are difficult to bring about
Consumer risk assumption for new energy projects	FERC approval for guaranteeing that costs of new energy projects will be covered by consumer rates	Consumer opposition

FERC = Federal Energy Regulatory Commission

know who holds valid mining claims,[1] it may be possible for a few firms to quietly gain control of large portions of the nation's uranium resources. Other energy resources are already allocated under leasing systems; however, modifications in procedures could enhance the opportunities of smaller firms. Two particular proposals which have been considered are to replace preference right leases on coal lands with a competitive bidding system, and also to institute a two-stage competitive bidding system for less well-mapped resources such as geothermal. The two-stage competitive bid awards an exploration lease to the firm which offers the lowest discovery bonus share--i.e., the exploration lease is awarded (stage 1) to the firm that agrees to accept the lowest share of revenues received if and when the discovered resource is commercially developed. At stage 2 bidding would be similar to conventional competitive bonus bidding methods, except it would take place only after economically workable quantities of an energy resource are discovered.[1] Another approach is to institute special lease procedures aimed at encouraging small firm activity. For example, the Department of the Interior reserved 35 percent of the oil and gas tracts off the coast of Massachusetts for leasing to smaller firms.[2]

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[1] U.S., Congress, Senate, Committee on Interior and Insular Affairs. Report to the Federal Trade Commission on Federal Energy Land Policy: Efficiency, Revenue, and Competition, Committee Print, by the Federal Trade Commission, Bureaus of Competition and Economics. Washington, D.C.: Government Printing Office, 1976, p. 671.

Energy consumers are another possible source for investment capital. Utility consumers could assume a major portion of the capital cost and associated risks of new projects if project costs could be recovered in consumer rates. This is essentially what has been proposed by DOE to assure financing for the first coal gasification facility proposed near Beulah, North Dakota.[3] The DOE plan would make gas customers effectively guarantee a majority of the cost, with a consortium of energy firms putting up the remainder. If this policy were to be employed for all synthetic fuel projects, capital availability would be a minor problem, since customers of gasification utilities would be assuming a majority of the investment risk.

10.3.3 Evaluation of Alternatives

This section will evaluate two of the three categories of policy alternatives identified for addressing capital availability problems:

- Provide financial subsidies to developers;
- Promote new sources for investment.

The alternatives will be evaluated and compared in terms of the five criteria used in other chapters and described below.

A. Evaluation Criteria

The five basic criteria used to evaluate the policy options are: effectiveness, efficiency, equity, flexibility, and implementability. Table 10-12 shows each criterion as it is defined

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[1] U.S., Congress, Senate, Committee on Interior and Insular Affairs. Report to the Federal Trade Commission on Federal Energy Land Policy: Efficiency, Revenue, and Competition, Committee Print, by the Federal Trade Commission, Bureaus of Competition and Economics. Washington, D.C.: Government Printing Office, 1976, pp. 734-35.

[2] Bernstein, Peter J. "System to Aid Small Firms." Denver Post, January 18, 1978.

[3] "How to Finance Gas Produced from Coal." Business Week, June 19, 1978, pp. 33, 36; "DOE Backs First Coal Gasification Plant." Oil and Gas Journal, Vol. 76 (June 12, 1978), p. 22.

TABLE 10-12: EVALUATIVE CRITERIA FOR ASSESSMENT OF CAPITAL AVAILABILITY ALTERNATIVES

CRITERIA	AS APPLIED TO CAPITAL AVAILABILITY	MEASURES
Effectiveness Achievement of policy objective	Is adequate investment capital available for western energy development? Is this a long-term or short-term solution? What degree of uncertainty is involved?	Quantitative Dollars for investment Duration of applicability Risk of failure Qualitative Types of risk reduced and remaining
Efficiency Costs, benefits, and risks	What are the costs of the alternative? What amount of investment is made available? What is the probability of financial failure?	Quantitative Dollars Probabilities Qualitative Partial investment in energy projects
Equity Distribution of costs, benefits, and risks	Who bears the costs of increasing capital? Which energy projects are aided? What is the relation between public and private sectors?	Quantitative Distribution of costs Qualitative Identification of projects, investors, sectors
Flexibility Adaptability to local conditions and times	Can the option be changed or reversed readily? Are variances possible?	Qualitative Extent of reversibility Variances
Implementability Possibility of being adopted	What existing laws, regulations, and programs need to be changed? Which parties, public and private, are affected?	Qualitative Changes required Parties involved

by the problems and issues in the context of capital availability for western energy development.

The effectiveness of alternatives is defined by the degree to which implementation strategies used are capable of achieving the policy objective of making adequate capital available for western energy development. This objective must also include consideration of short- and long-term effectiveness and the degree of risk remaining for the private sector.

Efficiency refers primarily to economic costs and benefits associated with a policy option, as well as the probability of financial failure. Equity here refers to the impact each alternative has on the various participants, such as those in the public sector and energy firms. The projects which benefit and the ultimate bearers of the cost are key elements of equity for capital availability options. Flexibility for these policy options refers to reversibility and the possibility of variances for special conditions. Reversibility is important for capital investment policies that may be appropriate to support new technologies (such as coal gasification) but could be prohibitively costly if and when a technology is widely deployed. Implementability of a policy alternative is determined by the institutional or legal changes that the alternative would require, and the values that are affected.

B. Evaluation of Financial Subsidies

The financial subsidies alternative includes tax incentives and price guarantees. While tax incentives can include a range of measures, such as accelerated depreciation, percentage depletion, and tax-exempt bonds, the following evaluation focuses primarily on investment tax credits.

(1) How Much New Capital Would Be Attracted?

Price guarantees could effectively reduce investors' risks, depending on the level of guarantee. If a potential investor is guaranteed a profit (that is, guaranteed a sufficient price floor), much of the risk of investing would be removed. Essentially, the market-price uncertainty, as well as the liability, would be transferred to the government. Price guarantees would also reduce some of the cost uncertainties associated with construction and operation. Of course, not all risks are removed since, for example, unexpected technical difficulties could raise costs above the price floor. Therefore, while price guarantees relieve investors of market price uncertainties, they do not totally eliminate the problem of capital exposure. That is, the developer must still raise funds at the time of construction, keep the funds tied up for a long time, and bear potentially disastrous risks of technical problems, strikes, etc. As brought out earlier (Table 10-3), the financing of a single, large facility would approximate the entire fixed assets of many would-be developers. Price guarantees help the ultimate profit potential of the larger firms which can get these projects under way, but getting started is the major hurdle for the smaller firms.

Tax preferences can take a number of forms, ranging from an increased investment tax credit to tax-exempt status for bonds. The relative effectiveness of these options depends critically on their amount and importance to individual firms. For example, the investment tax credit is presently limited to 50 percent of a firm's net income, thus restricting many utilities in their utilization of this credit. It is therefore not only the percentage of the credit but the maximum credit allowed that affects its effectiveness. Generally speaking, the strength of price guarantees is the weakness of tax preferences, and vice-versa. An investment tax credit removes little of the market-price uncertainty of investments and does not guarantee to the investor a profitable operation once the facility is functioning. Tax credits do have the advantage of reducing capital exposure by allowing the developer to recapture part of its capital almost immediately. Of course, without sufficient profits the tax credit would not be effective; this appears to be a problem not only for many smaller firms but also some large electric utilities.

A factor which potentially limits the effectiveness of the investment tax credit is that the percentage can be changed annually in the tax code, which increases the uncertainty of the profitability of the investment. For example, if investments were made in anticipation of large credits, the firm gambles that the credit would not change during the construction period, which can often last 8 years, or longer. The investment tax credit has had an erratic recent history, and, therefore, this uncertainty may reduce its effectiveness as a means of increasing investment in large-scale energy facilities.

(2) What Are the Costs, Benefits, and Risks of Financial Subsidies?

The costs of government subsidies depend on the range of energy facilities covered and the extent of the subsidy. Subsidies (particularly price guarantees) would be quite inefficient in the traditional economic sense, since they would support technologies that are not economical at existing market prices. The resulting disparity and liability, of course, will rest on the government and the taxpayers. The benefits of technological improvements and increased domestic energy production, therefore, must be balanced against these costs.

In the case of price guarantees, the incurred liability of government to support such technologies could be quite substantial. Current projections by the ERA estimate gasified coal at $5.50 per million British thermal units in 1978 dollars, compared to $2.26

for domestic gas and roughly $4.20 for Alaskan imported gas.[1] Thus, the amount of the guarantee or subsidy could be $1.30 over the price of Alaskan gas, implying a subsidy to a 250 million cubic foot per day gasification plant of about $110 million per year, roughly the entire annual operating cost for such a facility (less interest charges and administration).

Naturally, the total liability that the government would incur with a price guarantee would depend on both the duration of the guarantee and the relationship between the market price and guaranteed price during that time frame. In 1975, the Synfuel Interagency Task Force of the President's Energy Resources Council used a dynamic simulation model (FIST) to estimate the federal liability incurred over various time periods and prices in the support of a shale oil plant. As the figures from the model indicate (see Table 10-13), a price guarantee could become quite expensive over the long run, depending on the rate of return, the time period of guarantees, and the real price of competing oil. For example, to guarantee a 15 percent discounted cash flow rate-of-return, for 20 years when oil costs $11/barrel (1975 dollars) would cost the government $157 million (1975 dollars). As market prices rise closer to the guarantee level, (which is generally expected in the case of natural gas), the subsidy would decrease. However, if the market price rises slowly or stays below the guaranteed price, the government could be supporting expensive energy supply sources for many years.

The investment tax credit has quite a different time pattern of cost. It shows up as a government cost in the form of foregone tax collections early in the life of the project. A ten percent investment tax credit on a billion dollar facility will reduce taxes by $100 million, assuming the firm can take advantage of the full credit. Later success or failure of the project will not affect the amount of subsidy.

Overall efficiency, i.e., results per dollar of expenditure, is difficult to predict. However, the price guarantee approach could possibly be made more efficient than the investment tax credit. With a statement of legislative intent to promote promising new energy technologies, administrators could be given some latitude in choosing facilities to support with price guarantees. By contrast, tax subsidies are generally applied "across the board." The IRS is not set up for making technical judgments based on engineering, environment, or economic factors.

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[1] "DOE Backs First Coal Gasification Plant." Oil and Gas Journal, Vol. 76 (June 12, 1978), p. 22.

TABLE 10-13: ANALYSIS OF PRICE GUARANTEE FOR A SHALE OIL PLANT
(50,000 crude barrels equivalent per day)

GUARANTEED RATE OF RETURN	PRICES RE-QUIRED FOR SPECIFIED RETURNS ($/bbl)	NET PRESENT VALUE (Discounted at 10 percent) COST TO GOVERNMENT (Millions)					
		2-YEAR TERMINATION		5-YEAR TERMINATION		20-YEAR LIFE	
		OIL $11/bbl	OIL $7/bbl	OIL $11/bbl	OIL $7/bbl	OIL $11/bbl	OIL $7/bbl
12 percent DCF	10.10	0	59	0	129	0	228
15 percent DCF	12.70	32	106	69	232	157	521
20 percent DCF	17.94	128	203	280	442	628	993

$/bbl = dollars per barrel
DCF = discounted cash flow, after taxes, on total capital

Source: U.S., Synfuels Interagency Task Force. Recommendations for a Synthetic Fuels Commercialization Program, Report submitted to the President's Energy Resource Council. Washington, D.C.: Government Printing Office, 1975, Vol. III.

(3) Who Bears the Costs and Who Benefits?

The fundamental feature of government subsidies is that the taxpayers ultimately pay for them. Tax preferences reduce federal revenues, while price guarantees involve direct expenditure of federal funds.

A major question concerning the equity of these policy alternatives is which facilities will be covered. If synthetic fuel facilities receive a benefit which, say, conventional gas producers do not, then those gas producers will be forced to face a new source of competition. The consumers of the synthetic gas, though, will benefit by paying market price, even though they are using gas which costs more than that to produce. This economic benefit to some consumers (since all parts of the country would probably not use synthetic gas) would be subsidized by all taxpayers, whether they would directly benefit or not. A benefit which taxpayers generally (i.e., the nation) presumably will get for their expenditure is some experimentation with and refinement of new energy technologies, which would be needed on a larger scale in the future and increased domestic energy supply with all of its implications (improved balance of payments, lower unemployment, etc.).

Another question concerning the equity of these policy alternatives is whether or not they favor the larger energy-related firms over the smaller ones. In the case of price guarantees and investment tax credits, the alternatives are definitely of more value to the larger companies. While price guarantees and tax credits will encourage the large companies to put up the initial capital necessary for the development of a facility, they do not help the smaller firms as much since their main problem is coming up with the initial capital necessary to begin such a plant. Given the advantages of price guarantees and tax preferences for the larger company, there is the possibility that the equity question may emerge into a regional conflict. Many of the eastern mines are owned by smaller firms whereas the western energy deposits are owned by large conglomerates which the price guarantee and tax incentive will assist. Hence, the eastern firms may consider the federal subsidies as unnecessarily shifting coal production to the West.

Another equity issue is also raised with respect to one of the tax incentives mentioned previously, tax-exempt bonds. When tax-free status is granted to bonds, investors are willing to accept substantially lower interest rates (about 2 percentage points lower). The government is implicitly making up the difference via lower income tax collections. The equity issue arises because usually it is the upper-income groups, for whom tax exemptions are most beneficial, who take advantage of such provisions.

(4) Are the Options Flexible?

In considering the flexibility of these financial subsidies, two aspects must be considered: the extent to which they can be tailored to specific technologies or facilities and the extent to which they can be modified over time as changing circumstances dictate. Since tax codes are changed almost on a yearly basis, the investment tax credit is a very flexible policy alternative in terms of allowing changes over time. It permits credits on a yearly basis and could be changed in annual tax code revisions. However, this flexibility can, as discussed previously, limit the effectiveness of tax credits since industry faces the risk of changing tax credits during the construction period for large energy facilities. With regard to tailoring the investment tax credit to specific technologies or facilities, the investment tax credit is not flexible. As noted previously, investment tax credits are generally applied "across the board." One possible solution to these problems would be to allow variances for certain industries which exempt them from future revisions (for some specified period of time), or which allow greater administrative discretion in expanding or reducing the tax credit. This option would, of course, require a revision in the tax code to set a maximum and minimum that policymakers could change as needed or apply to specific industries without annual tax code revision. This could provide industry with some greater stability and yet assure taxpayers that they will not be locked into costly long-term policies.

In contrast to the investment tax credit, price guarantees could easily be tailored to specific technologies (or even to individual plants as part of a demonstration program) but they are not inherently flexible over time. A price guarantee program can be terminated at any time, but this would not retroactively affect facilities already in operation or under construction. Of course, flexibility could be enhanced by initially designing the price guarantee program so it only lasts for a particular facility for a relatively short time (say 5 years) but this approach would also seriously limit its effectiveness in attracting investment capital.

(5) Are the Financial Subsidies Alternatives Implementable?

A major problem in choosing specific policy alternatives for providing financial subsidies to energy developers is that policies that are attractive to industry may be opposed by other parties, such as the taxpayer who will bear the costs or proponents of competing energy options (e.g., solar). Nevertheless, generally speaking, the various financial subsidy policies, depending on the specifics of each, can probably find support among policymakers. Tax preferences, especially, have considerable precedent in our history and do not involve a new approach to economic policy.

Price guarantees, on the other hand, have not generally been used for industrial products although there is a long history of their use for agricultural production. Overall, the precedents and the belief that new, alternative energy technologies should be supported would suggest that generally financial subsidy policies are acceptable to the majority of the taxpayers.

However, allowing substantial administrative discretion with the investment tax credit in order to provide increased flexibility, as discussed previously, would require major policymaking changes, and seriously challenge long standing traditional values. Decisionmaking in the tax area is traditionally left to the legislative body. An increase in administrative discretion in these areas would probably be difficult to achieve.

Opposition to the price support alternative can probably be expected from some individuals and groups based on the cost and the time period involved. This alternative causes concern among those who fear expensive price supports over an indefinite period of time. Since the technologies are not developed to a point where they are competitive in the market place, the taxpayers will have to pay the difference between the cost and the market price. Also, all taxpayers will be paying for the energy used by a small part of the public.

In order for this alternative to gain the support necessary from both the energy industry and other parties to gain acceptance, the interests of both will have to be protected. The greatest concern would seem to be clear legislative intent that the program will not perpetuate itself, but only serve to encourage a nascent industry until it either becomes self-supporting or reaches a point where long-term success has been shown to be unachievable. The program will also have to be administered in such a way as to limit the number of new facilities involved until the technology is proven to be either worthwhile, or too costly.

(6) Summary Evaluation of the Financial Subsidies Alternatives

Table 10-14 summarizes the findings about financial subsidies. These alternatives are potentially very effective because they can bring directly to bear the vast resources of the federal government. This aid, however, will still call for most of the investment capital to come from the private sector. The subsidies considered here improve the expected profitability of energy ventures, but leave with the private sector the task of raising most of the initial investment. Firms facing significant financial constraints--small firms and many electric utilities--may not be able to take full advantage of such programs.

The costs to be borne by the general taxpayer could be substantial. Hence, the implementing legislation must carefully circumscribe the role of administrative discretion. On the one hand,

TABLE 10-14: SUMMARY EVALUATION OF FINANCIAL SUBSIDIES STRATEGIES

CRITERIA	MEASURES	FINDINGS
Effectiveness	Investment made available	Difficult to quantify. Depends on federal commitment and the attractiveness relative to other investment opportunities. Relatively more useful for larger firms.
	Duration of application	Temporary programs--until commercial feasibility either occurs or is proven impossible.
	Risk reduction	Only minor reduction in private sector's capital exposure, but profit potential greatly improved for those firms which can raise the "ante."
Efficiency	Costs	Potentially great. Subsidy for SNG plant could be on the order of its total operating and maintenance cost.
	Probability of failure	Price guarantees could be set so as to prevent private financial failure. Tax subsidies leave investors with substantial risks.
Equity	Who bears cost?	Taxpayers generally. Also, firms not selected for subsidies may face increased competitive pressure.

TABLE 10-14: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity (Continued)	Who gains?	Since these strategies do not greatly reduce risk, only firms with strong capital structures will be able to take advantage of them. To some extent this may favor western coal producers over eastern ones, and unregulated industries over electric utilities. Nation gains from increased domestic energy production.
Flexibility	Adaptability	These strategies can all be made flexible to the extent that the legislation allows administrative discretion. Price guarantees more suitable for this than tax incentives.
Implementability	Institutional changes	Considerable precedent for these programs in other fields, but administrative flexibility (especially with tax mechanisms) would be a radical departure.
	Affected parties	Taxpayer groups may oppose expenditure programs which could become self-perpetuating. Industries and firms excluded from benefits may resent those which are included, especially if they are competing in the same markets.

administrators should be enabled to select only those projects which are most needed to demonstrate and commercialize new technologies. On the other hand, taxpayers must be given assurance that aid will be terminated when a technology either becomes profitable or is shown to be uneconomic.

C. Evaluation of Promoting New Sources of Investment

Within these categories of alternatives (promoting new sources of investment), two specific alternatives are being considered. One deals generally with improving the leasing systems used for making federally owned energy resources available for development. The second aims at making energy consumers major sources of investment capital through the use of charges to consumers for the costs of energy facility projects under construction.

(1) Will More Investment in Western Energy Development Be Made?

Current regulatory requirements, such as uranium patenting and preference right leasing, often release federally owned minerals for token fees. Any new laws or regulations which increase developer payments to the federal government will tend to reduce the number of potential mine sites which industry would consider for development. For this reason, it is possible that improved leasing systems could decrease the total capital made available for western energy development.

On the other hand, if wider opportunities to participate are created, more participants and a more competitive energy market could eventually change. It is also possible that streamlined leasing procedures could increase the total pace of development. For hard-rock minerals such as uranium, the current system is so chaotic that there may be seven or eight claims on a single piece of land, with many legal bases for one to challenge another. One report strongly suggests that gaps and anomalies in the legal structure create confusion and vexatious litigation.[1] By making the parties' rights clearer, a leasing system for making uranium resources available for development could reduce costs and introduce more certainty. In the case of poorly mapped resources (geothermal, oil, and gas), the two-stage competitive bidding system described previously could also attract greater industry participation by reducing risks. This is because the larger cash outlays for a production lease, do not have to be made until the exploration stage is completed. The net effect of these forces is difficult to predict, but on balance, the improved leasing systems will probably decrease investment capital for western energy development due to substantially increased bonus bid and royalty payments to the federal government.

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[1] U.S., Congress, Senate, Committee on Interior and Insular Affairs. Report to the Federal Trade Commission on Federal Energy Land Policy: Efficiency, Revenue, and Competition, Committee Print, by the Federal Trade Commission, Bureaus of Competition and Economics. Washington, D.C.: Government Printing Office, 1976, p. 666.

The other specific alternative being considered, consumer risk assumption, will probably spell the difference between feasibility and failure for many energy conversion projects. This option can be implemented in the case of regulated industries, where the monopoly situation leaves consumers little choice but to accept special assessments in the case of project failure. Moreover, the regulatory framework facilitates other devices to improve the developers' prospects, such as rolled-in pricing and recovery of interest during construction.[1] In fact, these devices have been coupled with the first application before the FERC for an "all-events tariff."[2] Such a regulatory package provides considerable security to the developers, and may be expected to substantially increase the number of gas companies who will adopt coal gasification.

(2) What Are the Costs and Risks of Investment from New Sources?

The proposed leasing reforms tend to increase the revenues collected by the government. As noted above, this may impair the willingness of industry to develop federally owned resources. It may also push upward the prices ultimately charged consumers for energy.

A quantitative estimate for revenue potential may be gained from previous experience with western coal leasing. The bonus payments received in 1974, at 2.44 cents per ton, were more than three times as large as in any previous year.[3] Still, the market value of coal in Utah (all the coal in question was in Utah) at that time was much greater--about $10. A 12.5-percent royalty (which is now Interior's goal) would have yielded $1.25/ton, or more than 50 times as much as actually was collected. Even allowing for the fact that bonuses are paid immediately, whereas royalties are deferred, collections were probably less than one-twentieth of what they could have been under a percentage bonus system. Applying a factor of 20 to the average bonus receipts of $2.09 million/year during 1966-71,[1] it may be surmised that more than $40 million dollars per year of potential revenue has not been collected. This figure would increase if, as expected, federal coal leasing activity reaches a faster pace than before the moratorium.

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[1] See Section 10.2.2 above.

[2] "DOE Backs First Coal Gasification Plant." Oil and Gas Journal, Vol. 76 (June 12, 1978), p. 22.

[3] U.S., Congress, Senate, Committee on Interior and Insular Affairs. Report to the Federal Trade Commission on Federal Energy Land Policy: Efficiency, Revenue, and Competition, Committee Print by the Federal Trade Commission, Bureaus of Competition and Economics. Washington, D.C.: Government Printing Office, 1976, Table 9.19.

Even the proponents of consumer risk assumption concede that coal gasisification, at its current stage of development entails greater economic cost than other gas sources. The ERA, in supporting a coal gasification project before FERC, estimated the gas cost at $5.50 (1978 currency), whereas the most expensive gas alternative (imported LNG) was only $4.27.[2] Consumers would not only be paying for the higher energy costs, but they also would be assuming a majority of the risks in the event of unexpected technical problems. Hopefully, experience gained in commercial scale synthetic fuels technology will lower the cost in the future, so that special financial provisions will not be needed indefinitely.

(3) Who Bears the Costs and Who Benefits?

As noted above, the revised leasing procedures would generate more revenue for the federal and state governments, thus constituting a benefit for taxpayers. On the other hand, these added fees will, to some extent, be passed along to energy consumers, although a prime rationale for these new leasing procedures is the enhancement of competitive forces which will tend to hold down energy prices. The developers would correspondingly absorb any added costs.

Clearly "consumer assumption of risk" implies that gas consumers will bear what are expected to be the higher costs of synthesized gas. Outside lenders would be guaranteed a complete return of their investment under the first "all events tariff" which has been proposed. This would be achieved mainly by a "cost of service tariff" being charged to the customers, sufficient to cover all costs of construction and operation. The pipeline companies would probably receive a somewhat lower rate of return on their equity (which represents 25 percent of the total investment), since the ERA has recommended that "appropriate consideration (be given) to the degree to which risks associated with this project are being preguaranteed by consumers."[1] In all other respects consumers bear any additional costs.

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[1] Issuance of new federal leases has been virtually halted since 1971, due to challenges by environmentalists and planning by the Interior Department for completely new procedures. Full resumption of new leasing is not expected before the mid-1980's. See Lee, L. Courtland, and David C. Russell. "Whatever Happened to Federal Coal Leasing?" Coal Mining and Processing, Vol. 14 (June 1977), pp. 60-63, 112; also Bagge, Carl. "Federal Leasing? In the 1980's Perhaps." Coal Mining and Processing, Vol. 15 (September 1978), p. 49.

[2] "DOE Backs First Coal Gasification Plant." Oil and Gas Journal, Vol. 76 (June 12, 1978), p. 22.

As noted previously, compared to other "supplemental" sources of gas, the Lurgi process will cost an additional $1.23/thousand cubic feet (in 1978 currency). A plant of 125 million cubic feet/day capacity would thus entail an added cost of $50.5 million per year, or about $6.30 per year for each of the participating companies' customers. This is a minimal estimate, since costs of new technologies tend to rise in the development stage, and even cheaper alternatives may become available. For example, a major gas discovery in Alberta has recently cast doubt on the economic viability of the Alaskan gas pipeline.[2]

Gas consumers and the public more generally do gain some benefits from the consumer assumption of risk alternative. Probably the most important is reliability of supply, as compared to imports and limited domestic reserves. In addition, experience with new conversion processes may lead to technological breakthroughs and eventually lower costs.

(4) Are the Options Flexible and Reversible?

The proposed leasing systems, by making the process more organized, make it at least potentially more flexible. The current system leaves the government in a rather passive position, with private companies nominating coal tracts and claiming uranium resources at times and places of their own choosing. A planned leasing program would give the government a greater opportunity to guide the pace of development, as well as concentrating it in areas which are the most environmentally acceptable. However, a basic restructuring of mineral leasing would require new legislation, hence would be virtually irreversible. Mining is currently regulated under laws enacted in 1872 and 1920. These periods of time indicate how infrequently fundamental legislation is passed in this area.

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[1] "DOE Backs First Coal Gasification Plant." Oil and Gas Journal, Vol. 76 (June 12, 1978), p. 22.

[2] See "A Halt to the Alaska Gas Line?" Business Week, September 25, 1978, pp. 155, 158.

The consumer assumption of risk alternative is very flexible because the FERC can make these decisions on a case-by-case basis. Once made, however, a decision would have to be adhered to over the life of a long-term contract of 20 or 30 years.

(5) How Much Innovation Will Be Required?

The proposed leasing changes would require new legislation and, as just noted, significant changes in minerals legislation come quite infrequently. Still, recent passage of a surface mining and reclamation act appears indicative of congressional interest in the mining field at this time. If new legislation were adopted, probably claims already recognized would be "grandfathered" into continued validity. Unfortunately, whether "grandfathering" is attempted or not, legal controversies over ownership could extend over a long period, as has already happened with oil shale.[1]

A feature of the streamline leasing procedures which would facilitate implementation is that they would be much simpler than the current, virtually chaotic system (especially in the case of uranium). Two-stage competitive bidding, however, would be administratively more complex than onestep bidding systems.

Consumer risk assumption could be implemented by the FERC without further legislative authorization. The FPC (predecessor to FERC) has traditionally disapproved of such devices, but DOE backing of the approach may now have some influence. Apparently DOE is now leaning this way because currently loan guarantee programs are too complicated and time-consuming.[2]

(6) Summary Evaluation of "New Sources of Capital" Strategies

A summary of the evaluation of this category of alternatives is given in Table 10-15. The resource leasing options may stimulate mining investment in the long run by making procedures more orderly. In the short run, though, mining may be impeded as both private firms and public regulators adjust to new "rules of the game." Firms will also have to pay higher royalties, which may discourage some development. Higher fees would be borne by the mining firms and these could be passed on to energy consumers depending on competitive market forces.

Consumer risk assumption via a device such as the "all events tariff" shifts most financial risk away from the developers, hence

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[1] Green, Carol, and Gay Cook. "U.S. Oil Shale Land Policy Called 'Mess.'" Denver Post, September 12, 1978, pp. 1, 12.

[2] "How to Finance Gas Produced From Coal." Business Week, June 19, 1978, p. 36.

TABLE 10-15: SUMMARY EVALUATION OF PROMOTING NEW SOURCES OF INVESTMENT

CRITERIA	MEASURES	FINDINGS
Effectiveness	Investment made available	The resource leasing options could actually reduce total investment due to higher payments to federal government. Consumer risk assumption would increase investment capital.
	Duration of application	Legislation for the resource leasing options would be relatively permanent. Consumer risk assumption would depend on the particular case at hand.
	Risk reduction	Resource leasing options would reduce risk by streamlining and reducing uncertainty. Consumer risk assumption shifts risks to the consumer.
Efficiency	Costs	Resource leasing options would increase the revenues collected by the government, but might also increase price to consumers. Consumer risk assumption could be quite expensive depending on the technology assumed and its corresponding uncertainties.
	Probability of failure	Resource leasing options do not appreciably change probability of failure. Special assessments in case of project failure would protect firms under consumer risk assumption.

TABLE 10-15: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity	Who bears costs?	The larger development firms and possibly their customers could lose under the resource leasing options. Consumers obviously bear the costs under consumer risk assumption.
	Who gains?	The federal government and the smaller development firms benefit most from resource leasing options. Marginally feasible energy conversion projects, particularly those sponsored by large firms, gain from consumer risk assumption.
Flexibility	Reversibility	The resource leasing options would require new legislation, hence would be virtually irreversible. Since the FERC has administrative discretion in consumer price assumption, such a program would be more easily reversible, except that each commitment would have to be adhered to over the life of the long-term contract.
	Variances	The resource leasing options offer greater potential flexibility for the government by better organizing the process. Consumer risk assumption is very flexible since the FERC can make decisions on a case-by-case basis.

TABLE 10-15: (Continued)

CRITERIA	MEASURES	FINDINGS
Implementability	Legal and regulatory changes	Resource leasing options would require new legislation. Consumer risk assumptions would require some change in philosophy on the part of FERC.
	Affected parties	All uranium and coal mining firms would have to adjust to new "rules of the game" in leasing. Consumers assume the risks involuntarily under consumer risk assumption. Conventional gas producers would face new competition.

FERC = Federal Energy Regulatory Commission could be very effective in stimulating investment. This could be a very costly alternative, though, unless significant breakthroughs are achieved in synfuels technology. In fact, a major rationale for this kind of subsidy is that promising technologies will be supported only temporarily until breakthroughs are made and/or conventional sources become just as expensive.

D. Summary Comparison of Capital Availability Alternatives

The effectiveness of these alternatives depends critically on the particular implementation method. In general, the subsidy alternative could be very effective because it brings directly to bear the financial resources of the federal government (see summary Table 10-16).

Very different kinds of firms would be involved in each of these alternatives. The "new sources" strategies reduce the risk of financial failure, hence could attract small firms or those facing financial constraints (e.g., some utilities). In fact, some options within this overall strategy could be deliberately designed to aid the smaller firm. By contrast, the subsidies alternative does not greatly reduce capital exposure--the amount of capital tied up for long periods and subject to possible loss; that is, statistically expected profitability is increased but substantial risks remain. Hence, participation would tend to be limited to well capitalized firms, such as integrated oil companies.

Most of the options considered here are inefficient in the economic sense, inasmuch as they promote the use of resources and technologies whose cost is greater than that of available alaternatives, such as imported oil. The primary rationale for their adoption is the need to balance economic efficiency with reduced dependence on foreign sources, and faster technological advancement. Additional economic costs are borne by taxpayers in the case of subsidies, and by energy consumers in the case of the consumer assumption of risk alternative. The costs and benefits and their distribution in the case of improved leasing systems is uncertain, but generally taxpayers should benefit through higher government revenues for the right to develop federally owned resources.

Implementation may come more readily for the subsidy strategies, especially in the case of the tax incentives alternative since it has considerable precedent and politically it may be more acceptable since it doesn't require government expenditure (rather, government revenues are reduced). The improved leasing system alternative, on the other hand, strongly affects well-defined groups, such as uranium and coal mining firms. Strategies such as consumer risk assumption go against the traditional orientation of agencies, such as the FERC, which would have to implement them, although it may be experimented with on a case-by-case basis.

TABLE 10-16: SUMMARY COMPARISON OF CAPITAL AVAILABILITY ALTERNATIVES

CRITERIA	MEASURES	FINDINGS
Effectiveness	Investment made available	Subsidy strategies potentially very effective, as they can bring directly to bear the huge financial resources of the federal government. Leasing options have uncertain effects.
	Duration of application	Subsidies are supposed to be temporary. New leasing legislation would probably be more permanent. Consumer risk assumption would be on case-by-case basis.
	Risk reduction	Consumer risk assumption virtually eliminates investors' risks. Subsidies do not reduce risks much.
Efficiency	Costs	Subsidies could be very expensive. Resource leasing options would actually benefit the government fiscally. Consumer assumption of risk would be expensive but would probably be on more limited basis than subsidies.
	Probability of failure	Price guarantee program probably only one which would prevent failures, due to relatively wide administrative discretion and mandate to support "promising" technologies.
Equity	Who bears costs?	Taxpayers bear subsidy costs; energy consumers bear "new sources" costs.

TABLE 10-16: (Continued)

CRITERIA	MEASURES	FINDINGS
Equity (Continued)	Who gains?	Firms need strong capital structure to take advantage of the subsidy programs considered here. Small firms benefit most from the new resource leasing options.
Flexibility	Reversibility	Leasing improvements would tend to be more permanent, but give government more administrative flexibility. Others are easily reversible.
	Variances	Most of these options allow administrators wide latitude. Only tax strategies tend to be administered inflexibly.
Implementability	Institutional changes	Subsidy strategies have considerable precedent in nonenergy fields; also, taxation policies do not require disbursement from federal budget. "New sources" strategies imply philosophical changes in the Congress and FERC.
	Affected parties	Subsidies have diffuse effect on many taxpayers. "New sources" impinge on more identifiable groups: uranium and coal mining firms, customers of certain gas utilities, etc.

FERC = Federal Energy Regulatory Commission

CHAPTER 11

TRANSPORTATION

EXECUTIVE SUMMARY

The demand for western energy resources largely comes from urban areas outside the West. This will require existing transportation facilities for raw resources (such as coal) and for converted energy forms (such as electricity) to be expanded. Many of the benefits associated with western energy are received outside the West, while the costs of expansion of energy transportation will be largely confined to the western states and other states along the transportation routes. Consequently, expansion of energy transportation networks raises difficult political issues, and often involves opposition by landowners, local and state governments, environmental groups, and owners of competing transportation modes.

Impacts

The extent of transportation impacts depends on the level of energy production in the western states. A scenario used throughout this study (amounting to national production of 124 quadrillion British thermal units [Btu's] [124 Q's] by the year 2000) results in the capital and land requirements for energy transportation facilities shown in Table 11ES-1. Coal slurry pipelines, as a new mode for shipping raw coal, would require large amounts of capital (up to $14.2 billion) for construction. Electric transmission lines will involve considerably lower costs, but will occupy the greatest quantities of land for their rights-of-way (up to 205,000 acres).

Railroads and coal slurry pipelines compete directly for large, long-term shipments to coal users such as electric utilities. On such shipments, railroads appear to have advantages when: (1) variable quantities are shipped over time; (2) there are multiple origins and destinations; and (3) established mainlines are used as routes. Slurry pipelines appear to be superior when: (1) large volumes of coal are shipped over long distances; (2) high rates of inflation occur; (3) coal mines are large and close together; (4) there is a large, secure market in one location; (5) large supplies of water are available; and (6) the terrain favors pipeline construction. The cost structures of rails and slurries also differ considerably. Pipelines will need to be built

TABLE 11ES-1: CAPITAL AND LAND REQUIREMENTS BY 2000 FOR THREE TRANSPORT MODES

MODE	CAPITAL COSTS (billions of 1975 dollars)	LAND (thousands of acres)
Coal Slurry Pipeline	14.2	184
Unit Trains	9.9	67
Electric Transmission	2.2	205

from scratch, requiring a large construction force but few permanent employees. Railroads, on the other hand, have much track in place and employ a large number of operational workers.

Environmental impacts of railroads primarily include noise, wildlife habitat fragmentation, and disruption of highway traffic in towns through which trains pass. These impacts have been present in the West, but would increase in intensity and frequency as western energy development expands. Slurry pipelines have their major effect in the consumption of water, estimated at 788 acre-feet per million tons of coal, which would come from water-scarce western locations. In addition, coal fines (very small particles of coal) will produce a sludge at the receiving end of a slurry line. Thus, both rails and slurries have their costs and advantages on specific aspects of energy transportation.

High-voltage electric transmission lines impact large quantities of land, since wide right-of-way corridors are required. As voltage is increased, wider corridors are required but fewer lines (and corridors) are needed at the higher voltages because of their larger carrying capacity. Thus, to cut both construction and land costs, and because of increasing size of power plants, utilities have been moving toward the higher voltage lines. In addition to land-use impacts, transmission lines have been associated with electric shock, electronic communication interference, and biological effects on both humans and animals (such as livestock). These problems, which may be minor or nonexistent at low voltages, become of more concern as voltages are increased.

The Policy Context

Energy transportation is a very fragmented policy area, in which routes and modes are selected by energy developers in the same manner as facility siting decisions are made (see Chapter 12). Until recently, relatively few conflicts arose over energy transportation. As greater quantities of coal, in particular, are developed, economic and physical impacts raise issues for transportation, both of raw coal and of electricity generated from coal.

The principal issues include:

- Railroads have had a virtual monopoly on coal traffic. Coal tends to be considerably more profitable than shipments of other commodities because it is sent in high-volume, long-distance shipments. Slurry pipelines provide an alternative to railroads for the most attractive traffic, and are opposed strongly by western railroads.

- There is some question whether the railroad industry will be able to provide adequate transportation capacity subject to environmental and related pressures. Some rail routes will have heavy traffic which, even if not resulting in bottlenecks, will create long delays at railroad crossings. A great deal of opposition to railroads has arisen in western towns along rail routes concerning health and safety aspects of trains blocking crossings for long periods of time (up to several hours each day). Most western towns have only one or two grade crossings and very few have an overpass or underpass.

- Largely because they will involve new construction, both slurry pipelines and electric transmission lines involve significant land use and aesthetic impacts. However, these types of concerns are usually less with pipelines since they are buried.

- The opposition to electric transmission lines has grown over more than land use, and has tended to focus on electric shock, communications interference, and possible effects on humans and livestock. Insufficient information is available to date to judge the biological effects, but farmers and other landowners throughout the country have steadfastly opposed several high voltage line (765 kilovolts [kV] and up) projects. A particular problem with state regulation of power line siting is the conflict at the state border due to differing state laws.

- The principal detrimental factor for coal slurry lines, which contrasts with their economic advantages, is their water consumption from water-short western sites. Agricultural and ranching interests in the West fear that slurries would threaten the regional water supply in the long run, even if new water sources are found. However, in comparison with electric power generation, slurry pipelines consume 23 to 39 percent less water per unit of coal burned or shipped. Rail shipment of coal requires negligible quantities of water.

These and other policy issues raised in the context of transportation of western energy can rarely be resolved at any single level. Federal, state, and local governments, farmers and ranchers, railroads, utilities, and other participants all have an interest in these issues. Together, these groups contribute to an uncertainty about the kind and level of opposition and support for any policy solution.

Alternative Policies

The policy objective chosen for addressing energy transportation issues was to provide adequate capacity for transporting energy resources produced in the West while minimizing undesirable environmental and socioeconomic impacts. As shown in Table 11ES-2, four categories of policy alternatives and some selected specific policy alternatives may be suggested toward achieving this objective. The coal-carrying capacity of railroads can be enhanced by route expansion, an increase in rates, and greater economic and regulatory stability. Adverse impacts of coal unit trains can be mitigated by improving safety at crossings, (generally by grade separations) and by reduction of train noise in communities. Coal slurry pipelines can be promoted as a complementary energy transport mode by granting them eminent domain. Impacts of high-voltage transmission lines (HVTL's) can be minimized by limiting voltage, increasing research on technological alternatives, such as high voltage direct current (DC) transmission, and instituting interstate planning for power line routes.

FINDINGS

Rails:

In order to utilize the supply of coal in the West, coal carrying capacity of railroads must be increased. Railroads should be able to physically meet the increased demand for track and rolling stock, provided the necessary investment capital is available. To meet projected demands, total investment outlays will approach $8 billion by 1985, which is considerably larger than the recent rate of capital outlays by railroads. Achieving investment of this magnitude and increasing rail capacity will require government policies that assure economic and regulatory stability for railroads. Policies of this type include an investment tax credit of 20 percent, federal loans, expedited procedures for discontinuing marginally cost-effective rail service, subsidies of new track outlays, and permitting long-term contracts.

TABLE 11ES-2: TRANSPORTATION POLICY ALTERNATIVES

CATEGORIES OF ALTERNATIVES	SPECIFIC POLICY ALTERNATIVE
Enhance coal-carrying capacity of railroads	Expand railroads in energy areas of the West Increase rail rates Assure economic and regulatory stability
Mitigate adverse impacts of unit trains	Improve safety and mobility for vehicles crossing rail routes Reduce train noise in communities
Promote coal slurry pipelines	Grant eminent domain to coal slurry pipelines
Minimize impacts of high-voltage transmission lines	Limit voltage Increase research on technological alternatives Institute interstate planning for high-voltage transmission line routes

Since coal transportation to centers is characterized by high volume and small seasonal fluctuations, long-term contracts for coal are more feasible than for other bulk commodities (such as grain) and would allow rail companies to plan investments with greater confidence in levels of future earnings. However, long-term contracts increase risks for the railroads since they specify a certain rate to be charged for the duration of the contract and miscalculation of costs and expected revenues could prove disastrous.

Improving rail capacity through government subsidies (e.g., investment tax credits or federal loans) is a more equitable method of spreading the costs of investment and operation among the beneficiaries of rail service compared to current practice. For example, consumers of power generated in coal-fired power plants are subsidizing noncoal rail operations by paying prices substantially above costs. Although there is considerable precedent for government subsidies for railroads, this approach may be difficult to implement given the current political disposition for balancing the federal budget.

Unit Trains:

The greatly increased amount of rail traffic resulting from energy development in the West will have substantial impact on communities along the major routes. Alternatives for reducing these impacts include improving safety signals at rail-vehicle crossings, constructing grade separations, noise barriers, or bypass lines around communities, and revising land-use plans along rights-of-way. However, little can be done to reduce the physical impacts except move the tracks away from people, or vice-versa. Alternatives ranging from most to least effective are: construction of rail by-passes around towns, construction of grade separations, upgrading rail-crossing safety devices, and construction of noise barriers.

Grade separations and track rerouting are the most costly of the alternatives, the former ranging between $750,000 and $1.5 million (depending on conditions), and the latter expected to cost $500,000 per mile for new double tracks.

A task force at the state level could be created in order to formulate plans to mitigate unit-train coal impacts. The task force, composed of representatives from railroads, local governments, and state and federal agencies would determine priorities for safety signals and grade separations and specify areas where rerouting of tracks around towns is desirable. The major implementation constraint is lack of adequate funds; increased federal funding for such posposes, with contributions from states and railroads, may be required.

Slurry Pipelines:

Coal slurry pipelines can feasibly transport western coal to distant demand centers, if eminent domain powers are granted by Congress and if sufficient water is available. In some cases, transportation of coal via slurry lines is cheaper than transport by rail. Generally coal slurry pipelines will allow coal to be economically transported farther outside the region than if just rail transport is used.

Extension of the right of eminent domain to slurry pipelines will promote competition among coal carriers, resulting in more efficient coal transportation from the West to the demand centers. However, slurries are relatively inflexible in terms of shipping capacity; they must be operated at a more or less constant volume of flow and at very high capacity between a fixed supply point and a fixed demand point. Thus, under no circumstances would slurry pipelines totally substitute for rail transport.

The physical impacts of slurry operations along the route are not as pronounced as those associated with rail operations. Generally, the lines will not be apparent except while excavating for construction or for repair of plugs or breaks in the line.

Extension of the right of eminent domain to coal slurry pipelines by Congress will be met with opposition from railroads, labor unions, and water scarce states such as Colorado and Wyoming. Railroads offer a higher level of operations employment and the financial strength of railroads will be lessened if traffic is lost to slurry pipelines. On the other hand, with a combined slurry pipeline/railroad system, there will be loss of threat to coal supply disruption due to railway strikes.

High-Voltage Transmission Lines:

Limiting voltage on HVTL's will reduce health and safety impacts along routes, but will increase the proliferation of lines and result in greater costs to power utilities and consumers. Costs vary greatly with the volatage level; for example, investment costs would be approximately one-third larger for 500 kV lines than for 765 kV lines in order to carry the same amount of power over a distance of 1,000 miles.

A second approach for reducing HVTL impacts is through increased support of DC transmission research and development. Impacts of DC transmission are generally less than those associated with alternating current (AC) transmission. Increased funding from government and industry is needed to increase DC efficiency in short-distance transmission to match its superiority to AC for long-distance applications.

Finally, adverse impacts of HVTL's may be reduced by improved interstate planning. Current procedures in which regulations and the control of right-of-way siting vary from state to state can create significant problems. While this option reduces flexibility for individual states and utilities, it may provide greater certainty and fewer delays in the siting process.

CHAPTER 11

TRANSPORTATION

11.1 INTRODUCTION

For western energy resources to be available where they are needed, they will have to be transported to demand centers in other regions of the country. Existing transportation facilities for raw resources (such as coal) and for converted energy forms (such as electricity) will have to be supplemented and in some cases expanded. The expected western coal production of 1,300 million tons annually by the year 2000 will require additional transport infrastructure.[1] Approximately half of the western coal mined is projected to be exported in raw form, which could result in the need for 3,500 miles of new railroad track and 11,000 miles of coal slurry pipelines. Mine-mouth conversion to electricity, accounting for about one-fifth of the coal produced, could require about 9,000 miles of high voltage transmission lines (HVTL's). The remainder of the coal is projected to be used in the production of synthetic oil and gas, which will require about 4,300 miles of 36-inch pipeline.[2]

But attempts to install or expand an energy transportation facility often prompts opposition from landowners, local and state governments, environmentalists, and owners of other transportation modes. Right-of-way acquisition has led to protracted conflicts, even in states with well-defined siting procedures. For example, despite public hearings during the siting process, HVTL construction sites were picketed recently in Minnesota.[1] In some cases, state authorities will not or legally cannot grant the power of eminent domain to a transportation mode which passes through the state without picking up or discharging a payload. It may be difficult to establish a federal procedure which both deals effectively with this problem and accommodates legitimate state interests.

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[1] This figure corresponds to the Low Demand Case of the Stanford Research Institute (SRI)-Gulf interfuel competition model used in our regional analysis. See Cazalet, Edward G., et al. A Western Regional Energy Development Study: Economics, Final Report, 2 vols. Menlo Park, Calif.: Stanford Research Institute, 1976. As used here, the "West" refers to the eight states in our study area: Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah, and Wyoming.

[2] See White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. II, Section 12.7, for details on anticipated production levels and transportation needs through the year 2000 according to SRI's Nominal Demand Case. More detailed projections on these shipments are presented in the following section.

Conflict has been especially pronounced in the case of proposed slurry pipelines for transporting coal long distances. The major issues concern the facts that slurry pipelines consume relatively large amounts of water and may reduce railroad revenues. However, even with competition from slurries, increased coal production would guarantee that western railroads will experience increased demand. In fact, railroads are likely to experience difficulties in raising the capital needed to expand facilities at the rate needed to meet increased needs.

In the following section, the transportation impacts of western energy resource development are summarized. These impacts are then related to the social and political context within which they will arise, and the problems and issues which are likely to result are identified and described. In the final section of this chapter alternative policies and implementing strategies for dealing with these problems and issues are identified, evaluated, and compared.

11.2 TRANSPORTATION PROBLEMS AND ISSUES

11.2.1 Transportation Impacts of Energy Resource Development

The anticipated expansion of western energy transportation facilities and the projected capital costs associated with the low level of development being considered for our eight-state study area are shown in Table 11-1. These data are based on Stanford Research Institute's (SRI) Low Demand Case which calls for an annual energy demand growth rate of approximately 2.1 percent and predicts a national energy supply of 124 quadrillion British thermal units (Btu's) (124 Q's) for the year 2000 with an end use demand of 67.97 Q's.[2] The SRI model traces the flows of products from sources to end uses by linking centers of supply regions to centers of demand regions. The results are an estimate of the gross flows of energy

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[1] "Troopers Arrest Eight in Power Protest." Denver Post, January 13, 1978.

[2] See Chapter 12 in White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977.

TABLE 11-1: INCREASED WESTERN ENERGY TRANSPORT, 1975-2000 (Low Demand Case)

MODE	ENERGY FORM	THROUGHPUTS[a]	CAPITAL COSTS (billions of 1975 dollars)
Slurry	Coal	350 MMtpy	14.2
Unit Train	Coal	306 MMtpy	9.9
Gas Pipeline	Gas from Coal	2.56 bcfd	3.93
DC Transmission	Electricity	29,600 MWe	2.17
Oil Pipeline	Shale Syncrude	1.79 MMbbl/day	.86
Total Capital Costs			31.06

MMtpy = million tons per year
bcfd = billion cubic feet per day
DC = direct current
MWe = megawatt-electric
MMbbl/day = million barrels per day

Source: White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. II, Tables 12-1, 12-2, 12-55.

[a] Quantities are adjusted to reflect equivalent throughputs over a standardized distance of 1,000 miles.

which can be expected, not the flows for any particular route. This model was used to estimate the magnitude of transportation activity that can be expected in (or to originate from) our study area.

If all of the coal called for by this scenario in the year 2000 is transported by rail, it would represent a growth of about 22 percent in the freight revenue for all commodities of the ten largest western railroads which currently haul coal (assuming an average revenue of $3.54 per ton). This projected increase in rail traffic would require a fleet of approximately 380 unit-trains, each consisting of five or more 3,000 horsepower locomotives and 100 hopper cars capable of transporting 100 tons of coal each. In

TABLE 11-2: LAND AND STEEL REQUIREMENTS
BY THE YEAR 2000
(Low Demand Case)[a]

MODE	LAND (thousands of acres)	STEEL (millions of tons
Unit Train	67	1.5
DC Transmission	205	NA
Coal Slurry Pipeline	184	5.9

DC = direct current NA = not available

Source: White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vols. II and IV.

[a] According to the Low Demand Case there will be an annual energy supply by the year 2000 of 124 quadrillion British thermal units; see Section 11.2.1 above.

all, this much rolling stock would consume in excess of 1.5 million tons of steel.[1]

The transportation modes necessary to move energy from the resource area to where it will be consumed vary considerably in their land and material requirements. These requirements are summarized in Table 11-2. Steel is the major material requirement, especially for coal slurry pipelines. Significant quantities (as much as 65,000 tons) of aluminum could also be used in electrical transmission.

Several economic characteristics of transportation modes are presented in Table 11-3. Oil pipelines are clearly the least expensive and most energy efficient means for transporting a given quantity of energy. Power lines are the most capital-intensive

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[1] National Coal Association. Coal Facts 1974-1975. Washington, D.C.: National Coal Association, 1974. These estimates of steel utilization do not include requirements for new track or replacements in the existing network. See White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. II, Table 12-68.

TABLE 11-3: COSTS AND OPERATING CHARACTERISTICS OF TRANSPORT MODES

MODE	SERVICE TO INTERMEDIATE POINTS	PERCENT OF TOTAL COST FRONT-ENDED[a]	ENERGY CONSUMPTION[b] (percent)	UNIT COST[c]
DC Power Lines	Yes	84.6	10 - 12	.008
Unit Trains	Yes/No[d]	12.2	2.5	.60
Pipelines				
Slurry	No	79.3	2.9	.75
Oil	Yes	73.1	1.1	.078
Gas	Yes	50.9	9.6	.56

Source: Cazalet, Edward G., et al. A Western Regional Energy Development Study: Economics, Final Report, 2 vols. Menlo Park, Calif.: Stanford Research Institute, 1976, Vol. II, Chapter VI.

[a] Percent of annualized cost accounted for by amortization of initial investment. Assumed annual carrying charge rate = 22.8 percent.

[b] Percent of energy input which is lost or consumed over a 1,000 mile route.

[c] In 1975 dollars per million British thermal units (except for direct current power lines which is per kilowatt-hour) of energy flow over 1,000 miles.

[d] Service to intermediate towns may be improved or worsened, depending on capacity utilization rate.

and least energy efficient mode. Of course, many other considerations enter into the decision to utilize a particular mode of transportation, especially specific requirements of the firms which supply and demand energy resources. For example, the use of HVTL's is contingent on the availability of sites for the power plant, the geographical distribution of projected demand growth, the existing grid, the kilovolt (kV) design choices available, and the availability of transmission line routes.

Slurry pipelines and railroads largely compete for the same coal traffic. According to Table 11-3, their unit costs vary by no more than 20 percent. Various studies have produced different conclusions about how costs compare. For instance, a 1975 Bureau of Mines study found that: "Neither (rail or slurry) is superior to the other in any broad spectrum. Yet for specific cases, one will undoubtedly be preferable to the other though likely by narrow margins."[1] An Office of Technology Assessment study concluded that: "If one ignores regulatory distortions and larger social costs, slurry pipelines can...transport coal more economically than can other modes under certain circumstances."[2]

The western coal transport system will probably evolve into a mixed system, with each transportation mode (including trucks and conveyors for short hauls) taking a share of the overall market. Railroads appear more economical in situations characterized by: (1) variable quantities to be shipped over time; (2) multiple points of origin and destination; and (3) routes which utilize already established mainlines.[3] Slurry pipelines are generally more economical when: (1) high volumes of coal are to be shipped over long distances; (2) low real interest rates are obtainable; (3) mines are large and close together; (4) there is a large, secure market in one location; (5) large supplies of inexpensive water are available; and (6) terrain favors pipeline construction.[4]

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[1] Campbell, T.C., and Sidney Katell. Long Distance Coal Transport: Unit Trains or Slurry Pipelines, Bureau of Mines Information Circular 8690. Washington, D.C.: Government Printing Office, 1975.

[2] U.S., Congress, Office of Technology Assessment, Coal Slurry Pipeline Project Staff. A Technology Assessment of Coal Slurry Pipelines. Washington, D.C.: Office of Technology Assessment, 1978, p. 15.

[3] See, among others, Rieber, Michael, and Shao Lee Soo. "Route Specific Cost Comparisons: Unit Trains, Coal Slurry Pipelines and Extra High Voltage Transmission," Appendix B in White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977.

[4] Office of Technology Assessment. Technology Assessment of Coal Slurry Pipelines, p. 15.

Differences in cost structure will lead to different transportation impacts on the western economy. Table 11-3 shows that railroads have the lowest proportion of their costs front-ended, implying that most of their costs are operational, because railroads employ a relatively large number of operational workers as compared to pipelines. Pipelines, on the other hand, require a large construction labor force and only a few permanent workers. In both cases, the workers' residences will be spread out along the whole length of the transport corridor, with some concentration at each end. Railroads, therefore, would contribute to greater long-term employment growth in the western economy. However, local governments will experience more beneficial direct fiscal effects from slurry lines since they would add a larger increment to the existing property tax base. According to a Wyoming state study, slurry lines bring $18,000 of assessed valuation for each permanent employee while railroads bring $6,800.[1]

A critical determinant of economic impacts is the status of excess capacity on the main rail routes. Although western rail lines are generally underutilized at the present time, increased coal transport could eventually result in delays for noncoal rail shipments. Of course, the reverse could also be the case if priority were given to the other commodities.[2]

If coal traffic continues to grow, railroads eventually will have to upgrade signaling systems, repair roadbeds, and build new track. Capacities under various configurations have been estimated as follows: 28 trains per day with single track, 65 for single and double track segments alternating each 10 miles, and 100 trains per day for double track.[3] One likely consequence would be that intermediate communities would receive faster and more reliable rail service.

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[1] Freudenthal, David D., Peter Ricciardelli, and Michael N. York. Coal Development Alternatives: An Assessment of Water Use and Economic Implications. Cheyenne, Wyo.: Wyoming, Department of Economic Planning and Development, 1974, Table VII-4.

[2] See U.S., Congress, Senate, Committee on Energy and Natural Resources, and Committee on Commerce, Science and Transportation. National Energy Transportation, Vol. I: Current Systems and Movements, Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977, p. 54.

[3] All of these are assumed to have centralized traffic control. See Harza Engineering Company. Analysis of Energy Projections and Implications for Resource Requirements, for the Missouri River Basin Commission, Yellowstone Level B Study. Chicago, Ill.: Harza Engineering Co., 1976, Table B-1.

In addition to these economic impacts, each of the transportation modes produces a range of environmental impacts along their routes. These impacts may be considered either technology-dependent, such as noise pollution associated with rail transport, or location-dependent, such as the disruption of highway traffic in communities caused by an increase in the number of unit trains. In either case, these impacts are a potential cause of conflict among the various participants in the development of energy resources within the eight-state study area and along the transportation routes.

Table 11-4 provides an overview of the types and intensity of impacts that currently are or can be experienced. It should be noted that most of these impacts are dependent on the interaction between technological and locational factors. Thus, the estimate that as few as 4 unit trains per day will cause outdoor noise annoyance levels within 1,000 feet of the tracks has different meanings depending on whether the rail route bisects numerous small communities or avoids populated areas altogether.

11.2.2 The Context of Transportation Issues in the West

Four modes--railroads, coal slurry pipelines, oil and gas pipelines, and HVTL's--are critical to the transportation of energy from the eight-state study area. Trucks and conveyors may also be important, particularly for short-distance hauls. Of these modes, three (all except oil and gas pipelines) are particularly involved in generating policy issues in western energy development.

As noted above, the transportation of energy from the West has already begun to generate conflicts among the various parties-at-interest in western energy development. These conflicts can be divided into three categories: economic, physical, and planning.

Economic conflicts have arisen among competing transportation modes, often because of the way each mode is regulated, but also because of each technology's resource requirements or its impact on the region's economic development potential. For instance, slurry pipelines require large quantities of water which threatens some western interests.

The physical impacts during construction and operation have produced conflict between the operators and impacted communities. Noise, aesthetic impacts, accidents, and other disruptive effects have become issues in many communities along transportation routes, which has increasingly involved all levels of government.

The third conflict-generating category is transportation planning, which involves the choice of transportation mode and route, and the acquisition of right-of-way. Active participation by a range of interested parties makes this the most potentially volatile of the three categories of conflicts.

TABLE 11-4: ESTIMATED PHYSICAL IMPACTS OF TRANSPORT MODES

MODES AND IMPACTS	EXTENT OF IMPACTS
Railroads	
Noise[a]	Average noise level rises rapidly to outdoor annoyance levels for 4 unit trains/day at distances within 1,000 feet and is fairly constant for traffic greater than 10 unit trains/day.
Accidents[b]	An average of 3.6 fatalities and 34.2 injuries per million miles would result in about one death and 10 injuries per year on a 1,000-mile route.
Barrier effects[c]	About $9.9 million valuation of delays to town traffic in Colorado in 1985.
Fires[d]	Railroads caused 7.4 percent of the wildfire property losses in Nebraska in 1972-6. Could increase substantially with new coal traffic.
Slurry Pipelines	
Water use [a]	788 acre-feet per million tons coal.[g]
Disposal of coal fines[e]	4.7 percent of coal dumped as sludge at receiving end.
Accidents[a]	Up to 100 acre-feet of slurry might be dumped; at least 3 week delay in restarting a 1,000 mile line.
HVTL	
Power loss[a]	10-12 percent over a 1,000 mile line.
Biological effects[f]	Hard to quantify. Includes shock, behavioral disorders, microsparking, skin tingling. Soviet Union has instituted time limits on occupational exposures to fields equivalent to those at ground level beneath 765 kV lines.
Trucks	
Road Damage	Dependent upon weight and velocity of truck.
Noise	Difficult to quantify. Depends on site-specific factors.

TABLE 11-4: (Continued)

MODES AND IMPACTS	EXTENT OF IMPACTS
Trucks (Continued)	
Air pollution	Not a significant factor since truck use primarily limited to low volume (uranium) or short hauls.
Accidents	Increased risk of traffic accidents. Special concern in case of radioactive materials.
Pipelines (Oil and Gas)	
Spills	Not believed to be a serious risk.
Fire and explosion	Not considered.

HVTL = high-voltage transmission lines

kV = kilovolts

[a] White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. II, Sections 12.7, and Vol. IV, Appendix B. These figures represent approximations.

[b] U.S., Department of Commerce. Statistical Abstract of the U.S. Washington, D.C.: Government Printing Office, 1975, pp. 559-86.

[c] URS Company. Coal Train Assessment, Final Report for Colorado Department of Highways. Denver, Colo.: URS, 1976, Table C-1.

[d] Derived from data in Westover, D.C. Nebraska Wildfires. Lincoln, Nebr.: Nebraska, Department of Forestry, 1977.

[e] Derived from data in Dina, M.L. "Operating Experience at the 1580-MW Coal Slurry Fired Generating Station." Paper presented at the International Conference on Slurry Transportation, Columbus, Ohio, February 3, 1976.

[f] Kornberg, Harry. "Concern Overhead." EPRI Journal, Vol. 2 (June/July 1977), pp. 6-13.

[g] Naturally the water requirements for slurries depend upon the characteristics of the pipeline and the coal. The Office of Technology Assessment, for example, estimates that water requirements for a coal slurry pipeline from Wyoming to Texas may range from 371 to 571 acre-feet per million tons coal. See U.S., Congress, Office of Technology Assessment, Coal Slurry Pipeline Project Staff. A Technology Assessment of Coal Slurry Pipelines. Washington, D.C.: Office of Technology Assessment, 1978, p. 88.

The remainder of this section discusses each of these conflict categories, their historical evolution, the participants and their values with regard to transportation modes, and the existing legal and institutional infrastructure.

A. Economic Conflicts

The economic basis for conflict among the parties-at-interest in energy transportation in the eight-state study area is closely related to the historical development of the region. The railroad was the mode of transportation which activated the growth of the region during the latter part of the nineteenth century. Oil and gas pipelines and HVTL's were introduced during the 1920's. In the case of each transportation technology, government subsidy and regulation of rate structures is a key feature and a critical point of conflict. For instance, disputes have arisen between railroad and trucking interests because federal money provided significant support for construction of the interstate highway system but not for improvement and development of rail lines. This initial support has been paid for in full through gasoline and tire taxes, and no subsidy exists. This governmental involvement in highway construction has had and continues to have a significant impact on the region's economic development.

(1) Railroads

Railroad development in the West was subsidized primarily by land grants. Between 1850 and 1871, approximately 54 million acres within our study area were given to railroad interests by the federal government (Table 11-5). Although the initial grants did not generally include mineral rights, the railroads often mortgaged or sold these lands in order to purchase prime agricultural lands and lands with mineral rights and timber.[1] Because the railroads often sold transportation and land package deals to incoming settlers, the railroad's control of productive lands along their routes greatly influenced the pattern of urban development and economic activity in the region.

Farmers, ranchers, and townspeople of the West soon perceived that the railroads, which had given them their opportunity, were "...eating up all the profits of agriculture by charging high freight rates for hauling grain and cattle to markets."[2] In addition to reducing the profit margin of early settlers by charging high freight rates for hauling agricultural and mineral exports, the high prices of manufactured goods brought into the area by

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[1] Mossman, Frank H., and Newton Morton. Principles of Transportation. New York, N.Y.: Ronald Press, 1957, pp. 38-39.

[2] Clark, D.E. The West in American History. New York, N.Y.: Thomas Y. Crowell, 1946, p. 620.

TABLE 11-5: FEDERAL LAND GRANTS TO RAILROADS IN THE WESTERN STUDY AREA

STATE	ACRES	PERCENT OF STATE AREA
Arizona	7,695,203	10.6
Colorado	3,757,673	5.6
Montana	14,736,919	15.6
New Mexico	3,355,179	4.3
North & South Dakota	16,697,490	23.7
Utah	2,230,085	4.1
Wyoming	5,749,051	9.2

Source: Henry, Robert S. "The Railroad Land Grant Legend in American History Texts," in Carstensen, Vernon, ed. The Public Lands. Madison, Wis.: University of Wisconsin Press, 1968, Table 2, p. 129.

rail from the industrial Northeast made the area relatively unattractive as a market and retarded its economic development.

In an early attempt to regulate rail rates, state railroad commissions established rate ceilings under which railroads had to operate.[1] However, railroad-sponsored lobbies and politicians generally dominated these commissions and the problem of rate abuse continued. When, in 1886, state control of intrastate transportation was affirmed by the Supreme Court's ruling in the Granger cases, federal action quickly followed in the form of the Act to Regulate Commerce (commonly known as the Interstate Commerce Act of 1887).[2] This act established a basis for federal price regulation in interstate transport and set a precedent for future federal intervention into virtually every aspect of rail and pipeline commerce. Table 11-6 gives an overview of other rail-related legislation and outlines the broad legal context for the movement of western energy.

This early federal and state rate regulation highlighted conflicts of interest among various groups in the West. For example, the banking industry has often been politically allied with railroad

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[1] Locklin, D. Phillip. Economics of Transportation. Homewood, Ill.: Richard D. Irwin, 1972, pp. 211-24.

[2] Interstate Commerce Act of 1887, 24 Stat. 379, Chapter 104, 49 U.S.C. §§ 1-27.

TABLE 11-6: KEY RAILROAD TRANSPORT LEGISLATION

ACT	GOAL
Transport Act of 1920	Established the "rule of rate making" in which the ICC was urged to initiate rates, and otherwise adjust rates in such manner as to provide a fair return on the carrier's investment. Further, the ICC was required to issue certificates of public convenience and necessity to railroads wishing to expand routes.
Emergency Transportation Act of 1933	Assigned the ICC the role of assuring "adequate" (minimum) carrier revenues.
Transportation Act of 1940	No carrier should be required to operate under a rate structure that will protect the traffic of a competing mode.
Reed-Bulwinkle Act of 1948	Legalized carrier rate associations founded for rate fixing purposes and placed their operation under ICC oversight.
Transportation Act of 1958	Reinforced the 1940 Act and encouraged intermodal umbrella rates for competitive purposes except where facts and circumstances dictated alternative strategies.
Railroad Revitalization and Regulatory Reform Act of 1976	Allows railroad operators greater flexibility in the areas of rate-making, provision and type of service and route abandonment.

ICC = Interstate Commerce Commission

Source: Heskett, James L., et al. Business Logistics. New York, N.Y.: Ronald Press, 1973, pp. 103-35; Guandolo, John. Transportation Law. Dubuque, Iowa: W.C. Brown, 1965, pp. 1-28; Snow, John W., and Mark Aron. "Assessment of the Regulatory Reform Sections of the Railroad Revitalization and Regulatory Reform Act," in MacAvoy, Paul W., and John W. Snow, eds. Rail-Road Revitalization and Regulatory Reform. Washington, D.C.: American Enterprise Institute for Public Policy Research, 1977, pp. 183-90.

interests in their conflicts with cattlemen, as represented for example, by the Wyoming Stock Growers Association.[1] The railroad industry also developed an extensive national lobbying effort characterized by the early rate-making associations and more recently by the Association of American Railroads (AAR). The former were comprised of representatives of the industry who met to determine rates among competing rail lines so that "rate wars" and such conflicts could be avoided.

Tight governmental regulation of railroads has benefited some financially while contributing to the failure of others. Regulation also led directly to a diversification of economic interests by western railroads and a lack of experimentation in terms of the provision of new service.[2] Further, the high fixed costs of railroads (debt service on roadbed and rolling stock, maintenance, and so forth) force the railroads to maintain a high level of traffic flow relative to capacity. It should be noted that all of the laws listed in Table 11-6 contain provisions designed to promote railroad consolidation. The objective is to achieve greater efficiency by scaling up the size of railroads and reducing competition.

In addition to regulation, railroads face a new economic issue in the West in the competition from coal slurry pipelines (slurries) for transporting coal from the region. Slurries would provide a point-to-point coal transport mode for electric utilities and other users based on long-term contracts lower than the railroads could match. The Slurry Transport Association argues that slurry pipelines would end rail monopolies, thereby lowering transportation costs, and would enhance the reliability of energy supply.[3]

Railroad companies generally argue that coal slurry pipelines could threaten their solvency by forcing them to lower freight rates to remain competitive.[1] Slurry pipelines, they argue, would cut into the railroads' most profitable and convenient hauls, i.e., those which transport large volumes of materials over long distances. In general, railroad companies believe that "it does not make good sense to encourage development of an unnecessary and duplicate system of transportation that would take away the very means of railroad survival."[2] William Dempsey, President of the AAR, told Congress in April, 1978 that in no way can slurry pipelines and railroads operate together.[3]

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[1] Richards, Bill. "Changes Sweep into Wyoming." *Washington Post*, June 21, 1977.

[2] Luna, Charles. *The UTU Handbook of Transportation in America*. New York, N.Y.: Popular Library, 1971, p. 66.

[3] Federation of Rocky Mountain States, Natural Resources Committee. *A Comparison of Unit Trains and Slurry Pipeline Transportation Costs*. Denver, Colo.: Federation of Rocky Mountain States, 1976, Appendix B.

The issue in part revolves around the capacity of the railroad industry to provide adequate transportation facilities to meet coal-use demand while responding to economic and environmental goals including efficient and reliable service.[4] Some aspects of this capacity issue include:

- Adequacy of rolling stock. These problems will be greatly intensified if the projections of demand for up to 38,000 new hopper cars, plus replacement of existing deteriorated rolling stock, are approached by the year 2000. However, railroads and shippers (who own a majority of new coal-hauling cars) may be able to obtain sufficient numbers of hopper cars and locomotives to pull them, even though significant backlogs presently exist.[1]

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[1] Federation of Rocky Mountain States, Natural Resources Committee. A Comparison of Unit Trains and Slurry Pipeline Transportation Costs. Denver, Colo.: Federation of Rocky Mountain States, 1976, Appendix B. This occurred in reaction to a slurry pipeline introduced in Ohio in 1957. The railroads responded by developing the unit train concept and after 6 years forced the pipeline out of operation. See U.S., Congress, Senate Committee on Energy and Natural Resources, and Committee on Commerce, Science and Transportation. National Energy Transportation, Vol. III: Issues and Problems, Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977, p. 196; and Hudson Institute. Research Analysis of Factors Affecting Transportation of Coal by Rail and Slurry Pipelines. Croton-on-Hudson, N.Y.: Hudson Institute, 1976, p. 11.

[2] Federation of Rocky Mountain States. Comparison of Transportation Costs, Appendix A.

[3] Bureau of National Affairs. "ICC Seeks Slurry Pipeline Jurisdiction as Railroad Industry Reaffirms Opposition." Energy Users Report, Current Report No. 24 (April 13, 1978), p. 25.

[4] Environmental effects of rail transportation are discussed in the following section on Conflicts Over Physical Impacts.

- Track capacity. Another aspect of physical capacity is whether the trackage can accommodate the probable number of trains between coal-producing points and coal consumers. Numerous stretches of track have been projected to be overloaded, given high future coal shipment projections.[2] This would result in greater shipment expense and time requirements because of the necessity to employ longer routes avoiding the bottlenecks. For example, at the present time coal shipment from Wyoming to eastern Oklahoma utilities takes 3 days longer than railroads initially expected.[3] However, changing the signalling system and adding some sections of track to a single line track may be able to double track capacity.[4]

- Financing capacity. The costs of expanding rail capacity to serve the greater production of western coal are roughly proportional to increases in coal production. Uncertainty about demand for western coal puts the necessary investment into equal uncertainty.

Equipment "trust certificates" (a form of mortgage) are generally used for financing railway equipment. The mobile nature of the equipment permits repossession and makes it effective collateral. While the increase in equipment necessary for coal movement may cause some increase in the yield of such certificates, the major coal moving railroads should be able to obtain the necessary rolling stock by this means or by leasing, if customer-owned equipment is not used.[5] Importantly, most western coal is moved in cars owned

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[1] Manalytics, Inc. Coal Transportation Capacity of the Existing Rail and Barge Network, 1985 and Beyond. Palo Alto, Calif.: Electric Power Research Institute, n.d., p. 6. As cited in U.S., Congress, Senate, Committee on Energy and Natural Resources, and Committee on Commerce, Science, and Transportation. National Energy Transportation, Vol. III: Issues and Problems, Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977, p. 461; and "Freight Car Orders Climbed 65% in May." Wall Street Journal, June 12, 1978.

[2] Manalytics, Inc. Coal Transportation Capacity, p. 6.

[3] Clock, Greg. "Coal Boom Causes Rail Growing Pains." Daily Oklahoman, September 24, 1978, p. 1.

[4] Senate Committees on Energy and Natural Resources, and Commerce, Science, and Transportation. National Energy Transportation, Vol. III.

[5] Ibid., p. 462.

LOW RETURN ON INVESTMENT

Despite expanding shipments of coal, railroads have comparatively low return on investment. Burlington Northern and Southern Pacific Transportation for example, have 2.1 percent and 2.5 percent rates of return on investment, respectively, which are so low that they claim that they can't raise needed equity capital without increasing freight rates.

--Drew, Christopher. "Texas Battle of Coal Hauling Rates Risks U.S. Energy Plan, Efforts to Lift Rail Net." Wall Street Journal, June 16, 1978, p. 16.

or leased by shippers, such as utilities, who pay for them through fuel cost adjustments passed directly to consumers.

Track and right-of-way, however, cannot be repossessed and sold; it is the condition of the company that gives them value. Railroads need to offer returns on investment competitive with those offered by other companies to obtain financing. Although the western railroads which will be moving a lot of coal are generally in better financial shape than most railroads, it is not clear that they have the current profitability to be able to obtain the requisite investment and maintenance funds (see box).[1]

One report estimates that the total capital investments required to be made by railroads to meet capacity and maintenance needs by 1985 equal about $40 billion, of which coal-related investments will conservatively require 10 percent.[2] This would amount to twice the recent annual level of capital outlays.

Railroad profits may need to improve significantly to attract the additional equity. Alternatively, help with financing may need to be provided by the federal government, customers, or others. Rates that permit railroads to be profitable enough to build for coal movement may make potential alternatives to rail transport (such as slurries) more attractive to shippers.[3]

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[1] U.S., Congress, Senate, Committee on Energy and Natural Resources, and Committee on Commerce, Science, and Transportation. National Energy Transportation, Vol. III: Issues and Problems, Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977, p. 462.

[2] Richard J. Barber Associates. The Railroads, Coal and the National Energy Plan: An Assessment of the Issue. Washington, D.C.: Richard J. Barber Associates, 1977, p. 37. As cited in Senate Committees on Energy and Natural Resources, and Commerce, Science, and Transportation. National Energy Transportation, Vol. III, p. 465.

[3] Senate Committees on Energy and Natural Resources, and Commerce, Science and Transportation. National Energy Transportation, Vol. III, p. 465.

All of the capacity problems discussed above depend on the economic health of the railroads, which in turn is related to restrictions on railroads in rate-making, common carrier requirements, entry into markets, and abandonment of lines.

- Rate-making restrictions include prohibition on long-term contracts and the exclusion of profit in determining reasonable rail rates. Current regulations require that rates be negotiated annually. Thus, both the utility and the railroad face uncertainty over future rail rates. Since transport costs may be increased annually and may represent as much as 50 to 70 percent of total fuel costs, protests by utilities are sometimes made (see box). However, utilities usually are permitted to pass coal transportation costs on to consumers without immediate review through "fuel cost adjustments." The Interstate Commerce Commission (ICC) is currently evaluating policies that would permit long-term contracts on a case-by-case basis and that would establish minimum and maximum freight rates on western coal.[1] Finally, concerning "reasonable" rail rates, the ICC and the courts have ruled that such rates do not include profits or a return on equity capital.[2] The Railroad Revitalization and Regulatory Reform Act (4-R Act) allows for a profit element in controlled rail rates, but the ICC has failed to implement this to date.

HAULING PRICES ESCALATE

When City Public Service Company of San Antonio, Texas, started building its coal-fired plant in 1973, Burlington Northern and Southern Pacific estimated coal shipment costs of $7.90 a ton, roughly equal to the cost of the coal at the mine in Wyoming. Later the price went to $10.93, then $11.94, while coal prices were fairly constant. When the railroads posted $18.23 in 1977, San Antonio protested. The railroads maintain they must charge substantially in excess of their costs along routes they monopolize in order to maintain service elsewhere. Interstate Commerce Commission has permitted other railroads to price transportation in excess of 20 percent above costs to locations in Arizona and to Houston, Texas.

--Drew, Christopher. "Texas Battle of Coal Hauling Rates Risks U.S. Energy Plan, Efforts to Lift Rail Net." Wall Street Journal, June 16, 1978, p. 17.

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[1] Information Letter, Association of American Railroads, May 25, 1978, p. 2. A mechanism for these changes exists in the Railroad Revitalization and Regulatory Reform Act (Pub. L. 94-210, 90 Stat. 31, 45 U.S.C. 801) of 1976, which permits a rate to stand for five years if more than $1 million is invested in related facilities.

[2] "Rules to Govern the Assembling and Presenting of Cost Evidence," 337 I.C.C. 315-18(1970), interpreted in Burlington-Northern, Inc. v. U.S., 555 F2d 536 (1977).

- Common carriage refers to the requirement that a transportation mode must carry, at published rates, the goods of all shippers who request the specified service.[1] Common carriers cannot treat shippers in either a discriminatory or a preferential manner, a restriction that has put some uncertainty on unit trains as a coal transport mode. For example, even if a long-term shipping arrangement exists, railroads may have to "bump" or reduce service to utilities in favor of new shippers who have an equal claim to the railroad's limited capacity.

- Entry into new areas and abandonment of lines can take place only with certification of public convenience and necessity. This poses a particular problem if a railroad wishes to eliminate some classes of traffic or to abandon entirely to avoid financial loss. Low-use routes are more common in the West than elsewhere in the country; 4.71 percent of the carloads go on "potentially uneconomic light density lines," compared with 1.24 percent in four other regions.[2] Although track abandonment in the West was less than the rate of 8.2 percent nationally from 1970-1976, applications were filed and/or granted for abandonment of 23 percent of the track in South Dakota during the same period (Table 11-7). Thus, rail capacity and use generally are decreasing on all but high-traffic routes. But, because of the restrictions on abandonment of low-use routes, rates must be high enough on high-volume routes to subsidize the others and maintain overall solvency. This may not be possible where there are viable alternatives for shippers of high-volume commodities such as coal.

(2) Slurry Pipelines

Slurries, as mentioned earlier, represent new competition with the railroads for long-distance coal transportation. Although coal slurry pipelines are common carriers by legality, they are contract carriers by nature, and pipeline financing requires long-term contracts. While the development of slurry pipelines would contribute to the use of western coal, uncertainty exists because there is no experience with slurries of the scale proposed (600-1,500 miles).[3]

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[1] Interstate Commerce Act of 1887, 74 Stat. 379.

[2] U.S., Department of Transportation. "Rail Abandonments and Their Impacts," in McAvoy, Paul, and John Snow, eds. Railroad Revitalization and Regulatory Reform. Washington, D.C.: American Enterprise Institute, 1977, p. 160.

[3] Guccione, E. "Railroads vs. Pipelines: There's Room For Both." Coal Mining and Processing, Vol. 15 (February 1978), pp. 48-51.

TABLE 11-7: APPROVED AND PENDING TRACK ABANDONMENTS 1971-1977

STATE	APPROVED		PENDING	
	NUMBER	MILES	NUMBER	MILES
Arizona	5	79	3	72
Colorado	9	110	4	50
Montana	6	142	2	69
New Mexico	3	58	1	14
North Dakota	4	145	3	28
South Dakota	13	461	5	322
Utah	7	44	1	4
Wyoming	5	86	0	0

Source: McAvoy, Paul, and John Snow, eds. Railroad Revitalization and Regulatory Reform. Washington, D.C.: American Enterprise Institute, 1977, pp. 152-53.

The potentially lower cost of slurry operation (Table 11-3) presents the principal competition to the railroads, and would especially affect western railroads. If slurries succeed as a major transportation mode, they could take over 25 percent of the total coal movement from the West in the year 2000.[1] This could create a revenue impact on western railroads of up to $628 million, and an impact on rail employment of more than 6 percent.[2] Offsetting pipeline employment will be only short-term during construction and would tend to exacerbate boomtown conditions in some towns as a 400-person construction force moves at about 40 miles per month along each pipeline.[3]

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[1] U.S., Congress, Office of Technology Assessment, Coal Slurry Pipeline Project Staff. A Technology Assessment of Coal Slurry Pipelines. Washington, D.C.: Office of Technology Assessment, 1978, p. 74.

[2] Ibid., pp. 75-77.

[3] Freudenthal, David D., Peter Ricciardelli, and Michael N. York. Coal Development Alternatives: An Assessment of Water Use and Economic Implications. Cheyenne, Wyo.: Wyoming, Department of Economic Planning and Development, 1974, p. 29.

The railroads have obstructed slurries primarily by not allowing them to cross railroad rights-of-way. Without the right of eminent domain, slurries may have difficulty in crossing, for example, the 49 sets of railroad tracks between Wyoming and Arkansas. However, the railroads, which had eminent domain rights as well as land grants during their expansion, have not been completely successful in attempting to restrict slurries from their rights-of-way. Slurry interests have won a number of cases in state courts.

In addition, much of the opposition to the pipelines is due to their water demand and other environmental factors; these are discussed in the section on conflict over physical impacts.

(3) High-Voltage Transmission Lines

Economic issues also arise over HVTL's, especially in terms of the choice of converting coal to electricity within the West and transporting the energy by HVTL's, or shipping coal out of the region by rail or pipeline. Since HVTL construction has benefited from federal subsidies, coal (and slurry) transport may be at a disadvantage in some situations. Federal subsidies for HVTL construction began under the Rural Electrification Act of 1935.[1] Under this act, rural areas are able to obtain the bulk of their financing from the Rural Electrification Administration at relatively low interest rates.[2] Much of the power generated by rural cooperatives in the West is exported, although privately-owned utilities account for the bulk of long distance transmission from the region.

Interstate flows of electricity have been federally regulated since 1935 when the Federal Power Act charged the Federal Power Commission (FPC) with the responsibility of "assuring an abundant supply of electricity throughout the United States with the greatest possible economy and with regard to the proper utilization and conservation of natural resources."[3] FPC jurisdiction in electric power ratemaking extends to interstate wholesale transactions[1] and setting of hydroelectric power rates. In 1977, the Federal Energy Regulatory Commission assumed these responsibilities. Intrastate flows are regulated by state utility commissions and interstate transfers between utilities require the approval of the affected states.[2]

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[1] "The Electric Century, 1874-1974, Commemorating Electrical World's One Hundredth Anniversary." Electrical World, Vol. 181 (June 1, 1974), p. 431.

[2] Arthur D. Little, Inc. "Capital Needs and Policy Choices in the Energy Industries," Part 3 of U.S., Federal Energy Administration. Project Independence Blueprint Final Task Force Report--Finance: Financing Project Independence, Financing Requirements of the Energy Industries and Capital Needs and Policy Choices in the Energy Industries. Washington, D.C.: Government Printing Office, 1974.

[3] Federal Power Act, Title II of Public Utility Act of 1935, Pub. L. 74-333, 49 Stat. 847, 848, 851; Natural Gas Act, Pub. L. 75-688, 52 Stat. 821.

It appears that HVTL's can achieve even greater economies of scale than they have to date. For instance, "electricity can be transmitted as effectively 300 miles over a 765 kV line as it can be transmitted 10 miles over a 138 kV line."[3] Each mile of transmission line can require from 15 to 20 acres of land. This demand for land, the competition with other land uses, and the economies of scale offered by larger lines largely explain why utilities have moved increasingly to higher voltages.[4] Table 11-8 includes a comparison of costs for the various alternating current (AC) voltages which shows that the higher the voltage the lower the overall costs. The choice of higher voltage lines reduces the amount of right-of-way that must be purchased and the number of lines and towers that must be built. Even though costs per line are higher for higher-voltage lines, the smaller number required (and the increasingly large size of power plants) makes HVTL's attractive to utilities.[5]

Table 11-8 compares various voltage-level AC HVTL's on the basis of costs for land and equipment for transmitting 51,000 megawatts a distance of 1,000 miles.[6] Higher voltage reduces the

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[1] These interstate transactions made up only 7.3 percent of total industry sales in 1970. Breyer, Stephen G., and Paul W. MacAvoy. Energy Regulation by the Federal Power Commission. Washington, D.C.: Brookings Institution, 1974.

[2] Ibid.

[3] U.S., Congress, Senate, Committee on Energy and Natural Resources, and Committee on Commerce, Science, and Transportation. National Energy Transportation, Vol. I: Current Systems and Movements, Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977, p. 357.

[4] Ibid., p. 358.

[5] In addition to these economic issues, the physical impacts of HVTL's have generated considerable concern; this is discussed in the next section on conflicts due to physical impacts.

[6] This is the amount of electricity projected to be produced in the West by the year 2000. See White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming, Chapter 11.

TABLE 11-8: COST COMPARISON FOR ALTERNATING CURRENT AND DIRECT CURRENT HIGH VOLTAGE TRANSMISSION LINES AT VARIOUS VOLTAGES
(for transmission of 51,000 megawatts-electric)

ALTERNATING CURRENT (AC)											
			LINE SYSTEM COST[c]		STATION COST[c]						
kV	CC[a] (MWe) (LINE SYSTEM)	NUMBER OF LINE SYSTEMS[b]	PER MILE ($10^3$$'s)	OVER 1,000 MILES ($10^9$$'s)	PER MILE ($10^3$$'s)	OVER 1,000 MILES PER 1,000 MILES ($10^9$$'s)	LAND USED[d] ACRES/ MILE	LAND COST ($4,000/ACRE) OVER 1,000 MILES	TERMINAL EQUIPMENT COST[c] ($10^3$$'s)	TOTAL EQUIPMENT COST[e] ($10^9$$'s)	TOTAL COST[f] ($10^9$$'s)
230	211.6	241	85	20.49	19	4.58	9.1	8.8	3	25.07	33.87
345	475	108	109	11.77	42	4.54	11.0	4.75	4	16.32	21.07
500	1,000	51	155	7.91	82	4.18	15.2	3.10	9	12.08	15.18
765	2,340	22	217	4.77	179	3.94	19.4	2.41	29	8.72	11.13
1,100	4,840	11	310	3.41	349	3.84	21.8	0.96	74	7.26	8.22
1,500	9,000	6	411	2.47	775	4.65	26.7	0.64	155	7.14	7.78
DIRECT CURRENT (DC)											
600	2,340[g]	22	280	6.16	0	0	21	1.43	130	6.16	7.59
800	4,500[h]	12	457	5.48	0	0	20	0.96	174	5.48	6.44

kV = kilovolt
MWe = megawatt-electric
$10^3$$'s = thousands of dollars
$10^9$$'s = billions of dollars

[a] Line system carrying capability = $(\frac{kV}{500})^2 \times 10^3$ megawatt (MW). See Battelle Pacific Northwest Laboratories. Regional Analysis of the U.S. Electric Power Industry, Vol. 6: Transmission Cost Analysis. Richland, Wash.: Battelle Pacific Northwest Laboratories, 1975, p. 15.

[b] Number of line systems = total capacity (51,000 MW)/system carrying capability.

[c] Compensation station. See Cirillo, R.R., et al. An Evaluation of Regional Trends in Power Plant Siting and Energy Transport. Argonne, Ill.: Argonne National Laboratory, Energy and Environmental Systems Division, 1977, p. 225, Table 5.40.

[d] Total land used = land used per line x number of line systems. Ibid, p. 225, Table 5.41.

[e] Equipment cost = line cost + compensation station cost + terminal cost.

[f] Land & equipment.

[g] Assumed to be similar to 765 kV AC.

[h] Assumed to be 4500 MWe.

number of transmission lines needed for this amount of electricity, but overall energy efficiency (or total line loss) is about the same at any voltage. Equipment costs, including towers, lines, compensation stations,[1] and terminal equipment, are all higher per mile per line for high voltage lines, but the total line cost, in particular, decreases because the number of lines decreases rapidly as voltage increases. Land requirements (and costs) similarly decline with increased voltage. The data illustrate clearly the economic incentive to utilize higher voltage transmission systems, but currently there are still technical problems in attaining voltages as high as 1,500 kV.

Table 11-8 also compares AC with direct current (DC) transmission, although exact comparisons by voltage are not possible. DC has several advantages over AC, most of them due to technological differences between the two. DC transmission is lower in cost for long distances, because no compensation stations are needed, line losses are lower, and less insulation is needed. However, DC is primarily a long-distance transmission form, and intermediate line tapping is costly, primarily because conversion stations to AC are necessary. Such converters are costly and require filters and land near the point of consumption.[2] These difficulties and the convenience of use of electricity intermediate between a power plant and a demand center have kept AC as the predominant HVTL form in the U.S.

(4) Other Modes

The movement of coal by truck has also caused some localized problems in the West. Truck transportation is used primarily in strip mining operations.[3] They cause traffic congestion in small towns, pollute the air, make noise, and damage road-beds. For example, it has been estimated that a three-axle coal truck, running on a well-maintained highway at the maximum legal load limit would cause damages annually requiring $8,000 in road maintenance costs while only paying $1,350 in licensing fees.[1] Most of the cost of maintaining roads falls on the state governments.

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[1] Compensation stations boost the voltage intermittently along the route to compensate decreases in voltage with transmission distance.

[2] Hingorani, Narain. "The Reemergence of DC in Modern Power Systems." EPRI Journal, Vol. 3 (June 1978), p. 7; and Montana, Department of Natural Resources and Conservation, Energy Planning Division. Draft Environmental Impact Statement on Colstrip Electric Generating Units 3 and 4, 500 Kilovolt Transmission Lines and Associated Facilities. Helena, Mont.: Department of Natural Resources and Conservation, 1974, Vol. 4, pp. 20-25.

[3] U.S., Department of Transportation, Coal Transportation Task Force. Transporting the Nation's Coal, A Preliminary Assessment, Report to the Secretary of Transportation. Washington, D.C.: Department of Transportation, 1978, p. II-3.

Oil and gas pipelines, funded almost entirely by private investors, became an important means of energy transport in the West during the 1930's. Unlike coal slurry pipelines, oil and gas pipelines were granted the power of eminent domain and have sparked little or no opposition. Some natural gas pipelines were constructed during the 1940's with the help of federal subsidies.[2] Since the oil and gas pipeline network in the West is not likely to expand significantly in the future, few major conflicts can be expected over economic effects of this form of energy transportation.

B. Conflicts Due to Physical Impacts

Regardless of the transportation mode chosen to export energy resources from the eight-state study region, areas along the routes will experience a variety of impacts. Although impacts vary considerably among technologies, they can be said to either disrupt human and/or animal communities or pose a threat to human health and safety. Following a brief description of the historical context of these problems, the physical impacts associated with railroads, oil and gas pipelines, power lines, and uranium transport are discussed in turn.

From a historical perspective, the railroad has had the greatest physical effects on the West. Between 1860 and 1885, the extension of railroads into the northern portion of the eight-state study area promoted economic development which in turn contributed to the extermination of the buffalo and, therefore, the end of the mobility of the Plains Indians. As discussed earlier, the railroad technology of the period accounted in large part for the spatial distribution of towns and farming activity in the West. The cattle industry, seeking to remain at the periphery of this westward movement of "civilization," set the stage for many of the classic and often bloody confrontations over land use in the region. And, for all its economic impacts,[3] the railroad industry was viewed by the majority of the West's population as a vital lifeline and harbinger of civilization and progress.[1]

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[1] U.S., Congress, Senate, Committee on Public Works, Subcommittee on Transportation. Energy Impacted Roads. Hearings, 94th Cong., 2d sess., May 26, 1976, p. 66. As cited in U.S., Congress, Senate, Committee on Energy and Natural Resources, and Committee on Commerce, Science, and Transportation. National Energy Transportation, Vol. I: Current Systems and Movements, Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977.

[2] Luna, Charles. The UTU Handbook of Transportation in America. New York, N.Y.: Popular Library, 1971, p. 66.

[3] See Section A above.

The other transportation modes, pipelines and HVTL's, are newcomers by comparison. As late as the 1930's there were few crude oil and natural gas pipelines in the area and these were largely peripheral to the national pipeline network that had evolved between the Gulf States and Midwest.[2] The use of HVTL's was limited to the region's metropolitan areas until enactment of the Rural Electrification Act in 1935.

The use of fossil fuels and transmission of electricity allowed the West to move away from a raw material-based economy toward industrialization. This was because fossil-fueled machinery replaced labor-intensive farm and ranch operations, freeing this agricultural labor force for other tasks. Simultaneously, industrial development in the West was largely based on the evolving electric-powered manufacturing machinery of the day.[3] As in the case of the railroad, this series of transformations and the range of social, economic, and environmental consequences they brought were welcomed in the West.

For the most part, these three transportation modes were not met with serious objections by the people of the West.[4] But during the past decade, objections have been raised concerning each of them.[5] As shown in our impact analysis reports, railroads and

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[1] See Clark, D.E. The West in American History. New York, N.Y.: Thomas Y. Crowell, 1946, pp. 448-628 for a detailed treatment of these occurrences. Other standard references include Webb, Walter P. The Great Plains. Boston, Mass.: Ginn, 1931; and Turner, Fredrick J. The Frontier in American History. New York, N.Y.: Holt, 1920.

[2] U.S., Congress, Senate, Committee on Energy and Natural Resources, and Committee on Commerce, Science, and Transportation. National Energy Transportation, Vol. I: Current Systems and Movements. Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977, pp. 1-10, 160-85.

[3] Landes, David S. The Unbound Prometheus. Cambridge, England: Cambridge University Press, 1969, Chapter 5.

[4] Ibid.

[5] See Chapters 1 and 2 for a broader discussion of the context of western energy resource development.

HTVL's are expected to undergo significant expansion in the West. If coal slurry pipelines are accepted, a virtually new industry will be established.[2] On the other hand, the existing oil and gas pipeline system will not be significantly expanded.

(1) Railroads

Railroads transport most of the coal in the region and are, therefore, highly visible. Perhaps the most controversial aspect of coal transport by railroads results from unit train movements through the small communities in the region. Unit trains usually consist of around 100 hopper cars holding 100 tons of coal each and are pulled by five or more diesel locomotives. Except for stops for labor changes and fuel, these trains move nonstop from origin to destination.[3] The effect on small communities can be particularly disruptive, because grade separations (overpasses and underpasses) are not common. The mayor of Lusk, Wyoming explains: "We get one freight a day through here now and that ties up traffic coming in or out of town."[4] In anticipating the increased unit train movement, Mayor Hammond summed up the worries of his constituency: "What do we do if there is a fire or if someone has a heart attack on the other side of the track when these unit trains start running? We just don't know what's going to happen."[5]

The Sierra Club has filed suit with the U.S. District Court in Washington in an attempt to force the Burlington Northern and Chicago and North Western Railroads to reassess the impacts of a proposed 113 mile link through the Wyoming coal fields.[6] This new route is projected to allow 30 to 48 unit trains to pass through a number of small towns daily. In addition, these trains would make 306 crossings of county highways in the area. Legal action

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[1] White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. II, Chapter 12. See also, White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming, Chapter 11.

[2] Ibid.

[3] Glover, T.O., et al. Unit Train Transportation of Coal, Bureau of Mines Information Circular 8444. Washington, D.C.: U.S., Department of the Interior, Bureau of Mines, 1970, p. 1.

[4] Richards, Bill. "Paying the Price for Western Energy." Washington Post, December 13, 1976, pp. A1, A4.

[5] Ibid.

[6] Ibid.

has been motivated by public safety as well as environmental concerns.

Human safety as well as economic concerns were at issue when the residents of Lusk, Wyoming, petitioned Burlington Northern to provide signals at railroad crossings in their community. The railroad's response in this case was: "the motoring public is the chief beneficiary of projects which improve crossing safety, and financial support of such projects should so reflect." However, state laws in the West generally maintain that it is "the duty of the railroad company to construct and maintain without compensation a crossing separated from the street by a bridge or otherwise when reasonable public safety and necessity are required."[1] Further, public utility commissions in several of the states within our study area often make decisions concerning the allocation of costs between railroads and towns.[2]

Loss of livestock due to train traffic is also an economic issue. Ruth Rice, a rancher and member of the Sheridan County, Wyoming, Board of County Commissioners, has lost livestock to unit trains; she and other westerners are ready to take action to deal with this problem. She has said: "We are finding out that we are all citizens and we have the same rights as the railroads and big mining companies. We may have created a monster in these trains. And when you deal with a monster you have to make sure you protect yourself."[3]

Railroads can also produce health impacts, primarily due to air and noise pollution. Windblown coal dust from uncovered hoppers in a unit train could possibly cause damage to surrounding vegetation while diesel engines contribute to local air pollution[1] However, neither of these effects is thought to be serious.

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[1] See, for example, St. Paul v. Great Northern Rail Road Co., 138 Minn. 25, 162 N.W. 788, in American Jurisprudence Legal Forms, 2nd ed. Rochester, N.Y.: Lawyers Co-operative Publishing Co. and San Francisco, Calif.: Bancroft-Whitney Co., 1972, Section 276.

[2] These states have various ways of allocating costs and regulating railroads. For more information, see Georgetown University, Center for Strategic and International Studies. National Coal Policy Project: Interim Report: Transportation Task Force. Washington, D.C.: Georgetown University, Center for Strategic and International Studies, 1977, pp. 29-30.

[3] Richards, Bill. "Paying the Price for Western Energy." Washington Post, December 13, 1976, p. A4. Three of our eight states (Colorado, Montana, and Wyoming) have statutes which place liability on the railroad for this cattle loss if the railroad has been negligent in its duty to supply and construct cattle fences along its right-of-way. Colorado--pursuant to 40-27-102 (Colo. Rev. Stat. 1973 [1976 Supp.]); Montana--under 72-40 (Rev. Codes of Montana 945 [1975 Supp.]); Wyoming--37-209 (Wyoming Statutes 1957 [1977 Supp.]).

On the other hand, noise pollution from the unit trains may be a significant impact in terms of the potential for daily and long-term human irritation and hearing loss. Each time a unit train passes, the noise level reaches a peak of over 100 decibels A-weighted (dBA) at a distance of 100 feet. This noise level would require two people one foot apart to shout to communicate.[2] The primary noise source from trains is the locomotive and the level is essentially independent of train speed. Engine noise levels will typically vary between 90 and 100 dBA; horns used at grade crossings are also quite noisy and have been measured at 110 dBA at 100 feet.[3] The Noise Control Act of 1972 requires the Environmental Protection Agency (EPA) to develop national noise control standards for interstate commerce by railroad according to best available technology[4] except where EPA and the Department of Transportation (DOT) deem that a local standard takes precedence as necessitated by special local conditions.[5] The AAR challenged the Act and this resulted in a federal court ruling that explcitly stated that EPA noise regulations applied to all rail equipment and facilities in all jurisdictions.[6] Current Railroad Noise Emission Standards limit the maximum permitted sound level from locomotives to 96 dBA at 100 feet from the track, with the standard dropping to 90 dBA for locomotives manufactured after 1979. These standards are based on current best practical technology and economic feasibility, and therefore apparently it is not feasible to restrict engine noise levels further below 90 dBA. The other major noise source is the wheel-track interface and this source is highly sensitive to train speed and track condition. These train car noise levels range from 75 to 85 dBA at 100 feet.[1]

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[1] Szabo, Michael F. Environmental Assessment of Coal Transportation. Cincinnati, Ohio: U.S., Environmental Protection Agency, Office of Research and Development, Industrial Environmental Research Laboratory, 1977, p. 1978.

[2] White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. II, p. 941.

[3] URS Company. Coal Train Assessment, Final Report for Colorado Department of Highways. Denver, Colo.: URS Company, 1976, p. V-8.

[4] Noise Control Act of 1972, Pub. L. 92-754, 86 Stat. 1234, 42 U.S.C.A. §§ 4901 et seq. (1973).

[5] Ibid., § 17(c)(2).

[6] Association of American Railroads et al. v. Costle, 562 F. 2d 1310 (1977).

The nonurban environment is also affected by railroads. Construction of new links will often require the removal of vegetation and landscape alteration, resulting in the fragmentation of local wildlife habitats and the disruption of ongoing natural processes such as erosion. Due to demand uncertainty, new rail line construction will likely be limited to small distances over the short term,[2] but our projections indicate that 3,500 miles of new track could be required by the year 2000. As mentioned previously, the operation of railroads can often result in prairie fires and destruction of livestock. Both are costly to rural inhabitants.

(2) Pipeline Conflicts

Of the three modes considered, oil and gas pipelines produce the fewest physical impacts. Construction of oil, gas, or coal slurry pipelines will incur some short-term environmental damage due to trenching and right-of-way clearance activities; however, much of the natural environment is restored after this phase. The exception is tree coverage which must be kept off pipeline right-of-way. Depending on surrounding vegetation, this may result in a situation where the pipelines themselves are not visible, but their right-of-way is clearly defined.

During operation, there is some danger of accidents at compressor stations associated with gas and oil pipelines. Also, explosions can result when high pressure gas pipelines are ruptured by excavation activities. In 1974, 4 fatalities and 20 injuries resulted from gas line explosions.[3] There is also the danger of spills from oil or coal slurry pipeline operations. Oil spills can produce severe impacts, especially if the oil enters rivers or lakes, but such events occur infrequently and the effects are usually short-term and highly localized. There is virtually no experience on which to judge the risks and effects of coal slurry spills, but this is not felt to be a major factor.

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[1] URS Company. Coal Train Assessment, Final Report for Colorado Department of Highways. Denver, Colo.: URS Company, 1976, p. V-8.

[2] U.S., Department of the Interior. The Need for a National System of Transportation and Utility Corridors. Washington, D.C.: Government Printing Office, 1975, p. IV-5.

[3] U.S., Congress, Senate, Committee on Energy and Natural Resources, and Committee on Commerce, Science, and Transportation. National Energy Transportation, Vol. I: Current Systems and Movements, Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977, p. 13.

(3) Electric Power Lines

It is not clear whether HVTL's will continue to be accepted passively in the West (or elsewhere). In several cases during the past few years, transmission line projects have been opposed, particularly by farmers and ranchers. Their objections focus on several factors including the negative visual impacts of the lines, annoyance to lifestyle, and safety. The negative visual impacts of HVTL's have not yet become an issue in the study area; however, landowners in other parts of the nation are objecting on the grounds that the presence of HVTL's reduces land values.[1] Similarly, opposition to annoyances such as radio and television static has begun to be voiced.[2] The possible impacts of transmission lines are summarized in Table 11-9. These impacts and reactions to them apply primarily to AC transmission; the alternative, DC, is discussed later.

Human safety is currently the focal point for protest against HVTL's in the study area. Farmers and ranchers have experienced electric shock while operating equipment or in metal barns near HVTL's. Residents of the area also are becoming aware of recent research findings that concluded: "biological effects will probably be induced in humans exposed to overhead lines and...such effects may be harmful."[3] These findings, presented to the New York Public Service Commission by Andrew Marino, concerned 765 kV lines in that state, but the argument has been used in a similar dispute in North Dakota.[4]

Two of the state legislatures in the study area are considering restructuring their HVTL approval process as a consequence of recent protests.[5] To date, organized environmentalist action in

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[1] Katz, Barbara J. "Reaching for the Switch: Maryland Neighborhoods Fight Super Power Line." Washington Post, December 11, 1977.

[2] "The New Opposition to High Voltage Lines." Business Week, November 7, 1977, p. 27.

[3] Bernstein, Peter. "High Voltage Power Lines Protested." Denver Post, February 8, 1978. Similar concerns are expressed in Young, Louise B. Power Over People. New York, N.Y.: Oxford University Press, 1973. It should be noted that some research debunks the magnitude of these health and biological impacts. See Miller, M.W., and G.E. Kaufman. "High Voltage Overhead." Environment, Vol. 20 (January/February 1978), pp. 6-15.

[4] "Troopers Arrest Eight in Power Protest." Denver Post, January 13, 1978. Marino also said, "the typical powerline over 80,000 volts (80 kV) is hazardous."

[5] "Opposition to High Voltage Lines."

TABLE 11-9: IMPACTS OF TRANSMISSION LINES ON THE ENVIRONMENT (alternating current only)

- Effects of Construction and Maintenance
  - Clearing of land within right-of-way
  - Clearing and maintenance of access roads
  - Soil compaction and other physical damage due to construction activities
  - Interference with agriculture due to towers
  - Aesthetic impact of towers and lines
- Hazard of Electric Shock from Contact with Lines
- Effects of Corona
  - Radio and television interference
  - Audible noise
  - Production of ozone and oxides of nitrogen
- Effects of Electric and Magnetic Fields
  - Fuel ignition by spark discharges
  - Induced electric shocks
  - Biological effects of electric and magnetic fields
  - Interference with cardiac pacemakers

Source: Miller, Morton W., and Gary E. Kaufman. "High Voltage Overhead." Environment, Vol. 20 (January/February 1978), p. 8.

this controversy has been minimal but this is likely to change. A spokesperson for the Sierra Club recently stated: "High voltage transmission has come up marginally in our litigation, but we may be getting into it directly if the action is going along as fast as it apparently is."[1] On the other side of the controversy, the utilities communicate a feeling of urgency in building new lines. A spokesperson for the American Electric Power Company said, "Without these high voltage lines, utilities may simply not be able to meet the growth in power demand over the next decade."[2]

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[1] "The New Opposition to High Voltage Lines." Business Week, November 7, 1977, p. 27.

[2] Ibid.

Legislation has been enacted in a number of states in recent years to attempt to avoid conflict by bringing diverse groups into the planning process. Yet an "open" process has not resolved the difficulties. The current public outcry on both sides of the border between North Dakota and Minnesota exemplifies the continuing problem. Both states have siting commissions that include separate procedures for siting HVTL's. In both cases, public participation is an integral part of these proceedings. Both state commissions granted the power of condemnation to the utilities involved (United Power Association and Cooperative Power Association) after considering evaluations of the environmental, social, and economic impacts. Yet there was still conflict when construction began.[1]

DC electric transmission does not create the electric field, corona, and shock hazards associated with AC lines, permitting a smaller right-of-way and less land-related impact. However, there is an unknown level of ground return through the soil and metallic structures such as pipelines that AC lines (which are grounded in an additional overhead line) do not cause.[2] Additional research on DC transmission is needed to provide data for evaluating and comparing the two HVTL systems.

(4) Coal Slurry Pipelines

The principal environmental conflict over coal slurry pipelines concerns their water consumption from water-scarce western coal areas. Some agricultural and ranching interests in the eight-state study area believe that water requirements for coal slurry lines would place an unnecessary burden on the regional water supply.[3] Several national environmental groups support this view.

Legislators representing the West have divergent viewpoints: Representative John Melcher (D-Montana), Chairman of the House Interior Subcommittee on Public Lands, opposes slurry pipelines. He bleieves that gaining access to the Madison Formation (a water-bearing geological structure underlying several western states) will be a key stumbling block for slurry pipelines.[4] Representative

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[1] "High Voltage Power Lines Protested." Denver Post, February 8, 1978, p. 27.

[2] Montana, Department of Natural Resources and Conservation, Energy Planning Division. Draft Environmental Impact Statement on Colstrip Electric Generating Units 3 and 4, 500 Kilovolt Transmission Lines and Associated Facilities. Helena, Mont.: Department of Natural Resources and Conservation, 1974, Vol. 4, pp. 20-25.

[3] See Corrigan, Richard. "Railroad Versus Coal Pipelines--New Showdown in the West." National Journal, Vol. 8 (March 6, 1976), p. 294.

[4] Ibid., p. 295.

Teno Roncalio (D-Wyoming) views slurry pipelines as a way to avoid the degradation of the western environment. He believes that slurry lines can accommodate large-scale coal development. One of his legislative assistants was quoted as saying that "...what we're trying to do is keep our skies clear. I think most people (in Wyoming) would rather see it (coal) shipped out of the state than consumed in it."[1]

On a comparative basis with other energy conversion and transport configurations, coal slurry is not particularly water-intensive. Table 11-10 shows that consumption of western water by slurry pipelines would be much lower than that for most forms of coal conversion carried out at the mine-mouth (gasification is an exception). The water requirement of electric power generation is far greater than any other type of coal use. The shipment of coal from the West by slurry pipelines will consume less western water than converting the coal within the region. Export of raw coal by rail or slurry involves the trade-off between water use and the disruptions of rail traffic to towns and roads along rail routes. The question of whether coal should be exported or converted in the West appears to be a question of equal importance to the rail-slurry conflict. Water use and HVTL and pipeline impacts are inherent in a choice of coal conversion in the region.

Slurries are able to use low-quality water, such as highly saline water that is unfit for agricultural, industrial, or drinking purposes. But in the Powder River Basin coal area, the origin of most of the anticipated slurry pipelines, most available water is usable. This means that competition with existing users remains a critical issue throughout the West.[2] The problems and issues in water allocation are discussed further in Chapter 4.

There is some disruption of land, vegetation, and wildlife during the construction of a slurry pipeline. Rights-of-way of 100 feet are required for the equipment so that as much as 12 acres per mile of pipeline could be impacted.[3] As long as environmentally sensitive areas such as marshes and refuge areas are avoided, the construction impacts of slurry pipelines will be temporary and minimal. Since many railroads already exist in the West, not as

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[1] See Corrigan, Richard. "Railroad Versus Coal Pipelines--New Showdown in the West." National Journal, Vol. 8 (March 6, 1976), p. 295.

[2] For example, see Strain, Peggy. "Water, Land, Life--It's All One in Valley Pipeline Debate." Denver Post, November 13, 1977.

[3] U.S., Congress, Office of Technology Assessment, Coal Slurry Pipeline Project Staff. A Technology Assessment of Coal Slurry Pipelines. Washington, D.C.: Office of Technology Assessment, 1978.

TABLE 11-10: WESTERN WATER REQUIREMENTS FOR ENERGY CONVERSION AND TRANSPORTATION

TRANSPORT MODE	SIZE	COAL USE[a] MMtpy	HIGH WET COOL[b] WATER USE acre-ft/yr	GALLONS WATER PER POUND COAL	GALLONS WATER PER 10^6 Btu IN PRODUCT
Electricity					
Power Plant	3,000 MWe	10.2-19.2	23,900-29,800	0.203-0.455	(e) 87-108 (th) 30-39
Gas					
Lurgi Gasification	250 MMscfd	7.3-19.6	4,100-6,300	0.052-0.101	17-25
Synthane Gasification	250 MMscfd	6.6- 9.6	7,700-8,700	0.151-0.214	27-31
Liquid					
Synthoil Liquefaction	100,000 bbl/day	12.0-12.2	9,200-11,800	0.124-0.157	14-18
Slurry Pipeline	25.0 MMtpy	25.0	18,400	0.120	15
Solid					
Rail Transport	25.0 MMtpy	25.0	N	N	N

MMtpy = million tons per year
acre-ft/yr = acre-feet per year
Btu = British thermal units
MWe = megawatt-electric
e = electric

th = thermal
MMscfd = million standard cubic feet per day
bbl/day = barrels per day
N = negligible

[a] White, Irvin L., *et al*. *Energy From the West: Impact Analysis Report*. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming. Coal use numbers were derived from the development descriptions at each of the specific sites examined. The gallons of water required per 10^6 Btu in product have been described in Chapter 3, Table 3-9 of the same report.

[b] High wet cooling assumes all wet cooling for the turbine condensers and gas compressor interstage coolers. Reduced water requirements for combinations of wet and dry cooling are presented in the above report.

much new right-of-way will be needed for them as will be needed to develop coal slurry pipelines in the West. But the environmental impacts on vegetation and wildlife of constructing new rail lines is longer term. It is easier to restore vegetation and wildlife habitat over underground slurry pipelines than along railroads.

During operation of a slurry pipeline, it is necessary to provide a pond at each pumping station to hold the upstream line volume if in case of emergency it has to be dumped. A pond of water is also provided at each station to flush out the downstream line segment as may be needed.[1] This represents an additional water and land-use impact of slurry pipelines.

Any slurry dumped as a result of a pipeline breakage would be placed in the holding ponds at each pumping station. This dumped slurry could not be easily reintroduced into the pipeline because standby equipment for dredging, mixing, and reinjecting into the pipeline would be needed. Pipeline breaks that occur between pumping stations could result in spilling of the slurry onto adjacent lands, but such breaks are expected to occur infrequently.[2]

Plugging of the line is another operational problem that may occur, as it has at the existing Black Mesa line in Arizona. After locating the plug, the line must be dug up and part of it replaced. While a line can be shut down for short periods of time (generally less than three days), when plugging occurs the entire line must be flushed, the plug located and dug out and the slurry reintroduced from the supply point. This could result in a disruption of service for almost three weeks. Utilities dependent on this coal will either have to have sufficient slurry in storage or find another source of coal during this time. Disposal of the flushing water also presents a problem because it is too dirty to use for cooling and does not have enough coal to clean it for use.[3]

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[1] Armbruster, F.E., and B.J. Candela. Research Analysis of Factors Affecting Transportation of Coal by Rail and Slurry Pipeline, Final Report. New York, N.Y.: Hudson Institute, 1976, Vol. 1, p. 12.

[2] Freudenthal, David D., Peter Ricciardelli, and Michael N. York. Coal Development Alternatives: An Assessment of Water Use and Economic Implications. Cheyenne, Wyo.: Wyoming, Department of Economic Planning and Development, 1974.

[3] Rieber, Michael, and Shao Lee Soo. "Route Specific Cost Comparisons: Unit Trains, Coal Slurry Pipelines and Extra High Voltage Transmission," Appendix B in White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. IV, p. 59.

Finally, at the receiving end of the pipeline, the water must be disposed of in some manner unless it is used by the conversion technology or is pumped back to its source. Centrifuges can separate most of the coal from the water. Additional treatment such as flocculation (chemicals added to cause settling of fine particles) can eliminate almost all of the solids content in the water but other chemicals may still be present in the water. All problems with handling of wastewater from a coal slurry operation have not been solved and there may be cause for some serious environmental concern.[1]

(5) Uranium Transport

Some 80 to 90 percent of the nation's uranium ore reserves and milling capacity are located in the eight-state western region. Yellowcake (processed uranium ore) containing about 80-85 percent uranium oxide from western mills will be transported by truck to uranium conversion facilities in Metropolis, Illinois, and Sallisaw, Oklahoma. This means that most yellowcake will be shipped eastward along Interstate Routes 40 and 70.[2] In 1975, about 9,600 tons of yellowcake was shipped from the West. (This is much less weight than the amount of coal carried by a single unit train.) Both the Nuclear Regulatory Commission and DOT regulate these movements.[3]

Although handling of radioactive material has become a highly visible national issue, yellowcake has a relatively low level of radioactivity and thus its potential dangers are minimal. Transporting yellowcake has not been a major issue surrounding western energy development. However, when accidents have occurred, there have been expressions of public concern. For example, a recent spill of 21 tons of yellowcake near Springfield, Colorado, prompted the state health department to ask federal authorities to require stronger containers on uranium trucks.[1]

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[1] U.S., Congress, Office of Technology Assessment, Coal Slurry Pipeline Project Staff. A Technology Assessment of Coal Slurry Pipelines. Washington, D.C.: Office of Technology Assessment, 1978, p. 122.

[2] White, Irvin L., et.al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977, Vol. II, Chapter 12, p. 408.

[3] U.S., Congress, Senate, Committee on Energy and Natural Resources, and Committee on Commerce, Science, and Transportation. National Energy Transportation, Vol. I: Current Systems and Movements, Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977, p. 450; and Atomic Energy Act of 1954, Pub. L. 83-703, 68 Stat. 919, as amended by Pub. L. 91-560, 84 Stat. 1472, 42 U.S.C. §§ 2207, 2092, 211 (1970). See also "Memorandum of Understanding Between AEC and DOT." 38 Fed. Reg. 8466 (April 2, 1973).

C. Planning (Route Selection) Conflicts

The expansion of transportation facilities for exporting energy results in conflicts over the availability of land and the selection of routes.[2] Historically, the federal government had a major role in land allocation in the West. Beginning with the federal land grants to railroads (see Section 11.2.2.A), the federal government distributed large amounts of land in the eight-state study area, much of it purchased by small farmers and ranchers under the Homestead Act of 1862.[3] The small allotments (160 acres) were too small for survival, particularly in the dry short-grass plains area.[4] As mentioned earlier, this precipitated some of the earliest land-use conflicts in the study area.

The situation today is much the same as it was in the 19th century, with the farm and cattle interests retaining a keen awareness of the land and the traditions that it holds. On the other hand, railroads, pipeline companies, and electric utilities want to move their products over the most cost-efficient routes available. At the same time, major shifts are occurring in the roles and responsibilities of various levels of government. State public utility commissions generally have the greatest control over route selection since they oversee the eminent domain process.

The newest ingredient in the transportation policy system is concern for the environment which adds to land availability and route selection problems and issues. One immediate effect of increased environmental concerns has been greater public participation in the review of proposed routes. With regard to federal lands, this occurs as a part of the review process mandated by the

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[1] Seldner, Joseph. "Accident Puts Focus on Transporting Hazardous Materials." Denver Post, October 6, 1977, p. 3.

[2] Land availability for mining is addressed in Chapter 7, Land Use, while the same question is addressed for conversion facilities in Chapter 12, Energy Facility Siting. See also Barnes, Peter. Land Use Resources in the United States. Washington, D.C.: New Republic, 1972.

[3] Clark, D.E. The West in American History. New York, N.Y.: Thomas Y. Crowell, 1946, Chapters 29, 30, 33, 34, 36, and 37.

[4] This is Walter Prescott Webb's thesis in Webb, W.P. The Great Plains. Boston, Mass.: Ginn, 1931.

National Environmental Policy Act.[1] Also, six of the eight states in our study area have enacted state environmental protection laws,[2] and several of them have placed state energy development under a comprehensive facility siting agency.[3] These state siting commissions authorize condemnation of lands necessary for transportation only after the conversion facility is approved and usually after it is under construction. Economics and potential environmental impacts are the central considerations in the process.[4] Table 11-11 indicates state siting commission control over transportation modes other than railroads.

The laws regarding right-of-way acquisition on federal and other lands are summarized in Table 11-12. On federal lands, environmental impact statements (EIS's) have added to the complexity of the process, particularly in the cases of pipelines and HVTL's. The acquisition of pipeline and HVTL rights-of-way on federal lands requires approval of the Secretary of the Interior.[5] Accommodation has been made for interagency and interdepartmental cooperation in these proceedings, particularly concerning the EIS process. For example, Environmental Criteria for Electric Transmission have been issued to ensure consistency.[6]

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[1] National Environmental Policy Act of 1969, Pub. L. 91-190, 83 Stat. 852, 42 U.S.C. §§ 4321-47 (1970).

[2] Utah and New Mexico are the exceptions. U.S., Council on Environmental Quality. Environmental Quality, Seventh Annual Report. Washington, D.C.: Government Printing Office, 1976, pp. 133-35.

[3] These states include Arizona, Montana, New Mexico, and North Dakota. Southern Interstate Nuclear Board. Power Plant Siting in the United States. Atlanta, Ga.: Southern Interstate Nuclear Board, 1976.

[4] An excellent example is Montana. See Montana Major Facility Siting Act, Chapter 8, §§ 70-814 through 70-816.

[5] For pipelines see 31 Stat. 790 (1901) and 43 U.S.C.A. § 5 (1974). These acts do not specifically include coal slurry lines in their provisions; however, permits to construct and operate coal slurry lines have been interpreted to fall under the 1901 act. For HVTL's, see 31 Stat. 790 (1901) and An Act Relating to Irrigation Distribution Systems, Pub. L. 91-487, 86 Stat. 804; 43 U.S.C. § 959 (1964). This gives discretionary power to the Secretary of the Interior in cases involving federal nonreserved lands.

[6] 43 C.F.R. § 2851.2-1(c)(6) (1976). Environmental Criteria for Electric Transmission text available from Superintendent of Documents, Government Printing Office, Washington, D.C.

TABLE 11-11: STATE CONTROL OF TRANSPORTATION SITING[a]

STATE	MODE	FACILITIES COVERED
Arizona	HVTL	$\geq$ 115 kilovolts (kV)
Montana	HVTL	Associated with facilities when $\geq$ 69 kV (except HVTL $\geq$ 230 kV if less than 10 miles in length)
	Pipelines	Gas and liquid hydrocarbons from gasification facilities producing $\geq$ 25 MMcfd or liquefaction facilities producing $\geq$ 25 thousand bbl/day. Also, pipelines for geothermal fluids are covered.
New Mexico	HVTL	When $\geq$ 230 kV
North Dakota	HVTL	All HVTL $\geq$ 230 kV. Any HVTL that do not follow quarter or whole section lines or paths of other transport modes.
	Pipelines	Gas or liquid carriage of coal, gas, water, or liquid hydrocarbons to or from conversion facilities.

HVTL = high voltage transmission line
$\geq$ = greater than or equal to
kV = kilovolt
MMcfd = million cubic feet per day
bbl/day = barrels per day

Source: Southern Interstate Nuclear Board. Power Plant Siting in the United States. Atlanta, Ga.: Southern Interstate Nuclear Board, 1976.

[a] These laws do not cover railroads nor, in some cases pipelines. These transportation modes are usually under the control of a state railroad commission or sections of the state public utility commission.

TABLE 11-12: TRANSPORT RIGHT-OF-WAY ACQUISITION[a]

OWNERSHIP	ACT OR REGULATION	PROVISION
Federal land Unreserved public domain (Bureau of Land Management)	General Right-of-Way Act, 18 Stat. 482 (1875), 43 U.S.C.A. § 934 (1964); 43 C.F.R. 2801.1 (1975)	Railroads can unilaterally claim 200-foot wide right-of-way.
National forest (Forest Service)	30 Stat. 1233 (1899), 16 U.S.C.A. §§ 522-25 (1974); 36 C.F.R. §§ 250 et seq. (1975); 43 C.F.R. § 285.2-1 (1975)	Secretary of the Interior may provide right-of-way, if public interests will not be injuriously affected.
Indian lands	25 U.S.C.A. §§ 312-24 (1963); 25 C.F.R. § 161.12 (1975)	Secretary of the Interior grants right-of-way subject to the written consent of and "fair market valuation" of individual land owners or the tribal council.
State land	Arizona Rev. Stat. § 12-1111(8) (1956) Colorado Rev. Stat. § 38-2-101 (1973) New Mexico Stat. Ann. § 22-91 (1953) Utah Code Ann. § 78-34-1 (1953) Wyoming Stat. § 1-754 (1957)	Eminent domain granted by states.[b]
Private land		Acquired through private negotiation or condemnation by state in cases where opposition is salient.

Source: Carey, Dwight L., et al. Study of Alternative Locations of Coal-Fired Electric Generating Plants to Supply Energy from Western Coal to the Department of Water Resources. Los Angeles, Calif.: University of California at Los Angeles, Institute of Geophysics, May 1977, Section 4.4.

[a] These means of acquiring use of state, federal, private and Indian lands are common to each of the transport modes considered here.

[b] Since these are often school lands that are being utilized for other uses, e.g., farming or ranching, the railroads often negotiate with the present lessee in order to satisfy state interests.

Because federal and state review processes now provide for the participation of many groups previously excluded from direct involvement, opportunities for conflict have increased. The private landowner whose land is under consideration for condemnation and the private interests that use public lands for grazing or recreation are no longer obliged to rely strictly on the energy developer or transportation company's economic decisions concerning "least-cost routes." Attitudes such as "we own the right-of-way and you must live with it"[1] have left a lingering impression on private landowners who now often use environmental and quality-of-life concerns to justify their challenge of new routes.

In considering long-range plans for conversion facilities and transportation routes, states with siting commissions seem to favor transportation corridors in which several modes or companies share a right-of-way. In response to a Congressional recommendation, the Bureau of Land Management has investigated the necessity and desirability of establishing a national system of transportation and utility corridors across federal lands.[2] A major stumbling block to this concept is a lack of cooperation among states along proposed routes. State right-of-way grants are often contingent upon the carrier demonstrating that energy shipments of an interstate nature constitute a benefit to the state.[3] (This has been a problem with western energy development where, for example, Arizona, New Mexico, and until recently, Colorado and Wyoming have reacted adversely to coal slurry pipelines.[4]) Thus, states that contain neither the origin of the route nor its destination may pose a problem for new energy transportation routes. For example, Nebraskans have begun to raise questions about the increase in unit train traffic on their railroad lines.[5]

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[1] A Wyoming mayor describing railroad attitudes, quoted in Richards, Bill. "Paying the Price for Western Energy." Washington Post, December 13, 1976, p. A4.

[2] U.S., Department of the Interior. The Need for a National System of Transportation and Utility Corridors. Washington, D.C.: Government Printing Office, 1975. This document advocates the identification and utilization of "planning corridors" which are several miles in width and which can accommodate different energy transportation facilities.

[3] Carey, Dwight L., et al. Study of Alternative Locations of Coal-Fired Electric Generating Plants to Supply Energy From Western Coal to the Department of Water Resources. Los Angeles, Calif.: University of California at Los Angeles, Institute of Geophysics, 1977, pp. 4-39 through 4-40.

[4] Ibid.

[5] Richards. "Price for Western Energy."

11.2.3 Summary of Problems and Issues

Railroads, slurry pipelines, HVTL's, and trucks are the transportation modes most likely to raise problems and issues in the transport of energy resources within and from the eight-state study area. Each of these modes has already produced conflicts among parties-at-interest over economic and physical impacts and associated planning and routing questions.

Economic conflicts are underscored by the history and operating characteristics of railroads. Price discrimination under monopoly conditions led to early federal regulation of rates; however, this monopoly persists, particularly in terms of transporting energy in bulk form such as coal. Coal slurry pipelines appear to be a technologically feasible and, in some cases, a price-competitive alternative to railroads. This is one reason the railroads have opposed them. Also, some citizens and state governmental officials have expressed concern that water requirements for slurry pipelines will deplete the region's already scarce water resources.

Conflict also arises over the physical impacts of each of the transportation modes. New corridors in the study region will cause environmental impacts, due to the removal of vegetation and the disruption of wildlife habitat. This can be a short-term phenomenon during construction in the cases of HVTL's and buried oil, gas, and slurry pipelines, but railroads would have continued effect during operation. Health and safety questions are also raised, particularly for unit trains which produce noise pollution and the risk of accidents. Small towns in particular will be disrupted since railroad routes within the study area tend to bisect them. Increased movements of unit trains extend the time frame within which these towns are effectively divided and increases concern about accidents at crossings. HVTL's meet with resistance because of their aesthetic effects, particularly in scenic areas, and their potential safety and health hazards. As a result, many state governments are reevaluating their HVTL regulatory programs. Even prior to the perceived health hazards, HVTL's were considered by many to be an irritant due to the static they cause in radio and television sets, and the noise and occasional electric shocks they produce.

Finally, conflicts arise in the planning (route selection) process due to the multiplicity of state jurisdictions that must be crossed, the checkerboard land ownership patterns within these jurisdictions, and legal mandates to account for environmental as well as economic criteria. There are private, state, federal, and Indian lands in the West. To be available for transportation uses, state and privately owned lands must be declared in the public domain by the responsible agency. These agencies have now expanded the criteria for making this decision beyond those traditionally used. States have adopted mechanisms for widespread public review of such decisions through siting commissions and state environmental protection programs. Use of federal and Indian reservation lands necessitates widespread federal agency participation through EIS's, certificates of need, and other requirements. States which are crossed by energy transportation facilities but which are not supply or demand centers are particularly reluctant to bear the impacts of these facilities.

These conflicts combine to create two major long-term energy transportation issues in this study area:

- How can energy transportation systems best be expanded to meet the projected levels of energy production in the eight-state study area?
- What roles should local, state and federal governments assume in assuring the movement of energy supply from the study area while protecting the well-being of its citizens?

11.3 POLICY ALTERNATIVES FOR TRANSPORTATION

11.3.1 Introduction

Increasing domestic energy production and protecting and enhancing the environment are both national policy objectives. As emphasized throughout this study, the West is expected to contribute significantly to increases in national energy production, and most of that contribution will be transported for consumption in other regions of the country. This energy transportation, as indicated in the preceding sections, will produce a range of impacts. Energy production and transportation goals can conflict with other policy goals, and policymakers will have to determine acceptable trade-offs.

The primary policy objective in the area of energy transportation is to provide adequate capacity for transporting energy resources produced in the West while minimizing undesirable environmental and socioeconomic impacts. In this section, four categories of policy alternatives are discussed, each focusing on a particular aspect of the policy objective of this chapter. These four categories of alternatives are:

- Enhance the coal carrying capacity of railroads;
- Mitigate the adverse impacts of unit trains;
- Promote coal slurry pipelines;
- Minimize the impacts of HVTL's.

Table 11-13 lists a number of specific policy alternatives in each of these four categories. It should be noted that broad concerns over the form of transported energy, such as the choice between exporting raw coal or converting it first to electricity are not

TABLE 11-13: TRANSPORTATION POLICY ALTERNATIVES

POLICY OBJECTIVE	CATEGORIES OF ALTERNATIVES	SPECIFIC POLICY ALTERNATIVE
Provide adequate capacity for transporting energy resources produced in the West while minimizing undesirable environmental and socioeconomic impacts	Enhance coal carrying capacity of railroads.	Expand railroads in energy areas of the West Increase rail rates Assure economic and regulatory stability
	Mitigate adverse impacts of unit trains	Improve safety and mobility for vehicles crossing rail routes Reduce train noise in communities
	Promote coal slurry pipelines	Grant eminent domain to coal slurry pipelines
	Minimize impacts of high-voltage transmission lines	Limit voltage Increase research on technological alternatives Institute interstate planning for HVTL routes

directly addressed in this chapter. Consequently, energy transportation choices are discussed with the assumption that such large scale policy choices (as discussed in Chapter 13) have already been made.

11.3.2 Description of Alternatives

The first category of alternatives primarily addresses the regulatory context in which the railroads operate, and includes alternatives for expansion, increasing rail rates, and assuring more stability in regulation. The second category is concerned with the impacts rather than the capacity of coal shipment by rail. The impacts fall into the principal categories of safety and noise, each of which suggests a specific policy alternative. The third category addresses coal slurry pipelines as a transport mode for coal that would be a viable alternative to railroad shipment. The fourth category includes policies to reduce the impacts and hazards of high-voltage electric transmission lines.

A. Enhance Capacity of Railroads

Enhancement of the economic and material resources of the rail transportation mode as a broad policy option can be achieved through specific policies and implementations that increase railroads' share of energy transport, increase the price per ton of coal shipped, or assure the economic stability of railroads through economic and regulatory guarantees or policies.

Railroads' share of energy transportation in the West is affected by decisions of mine-mouth or demand-center conversion facility siting, competition with other transport modes, and state and national policies that affect the attractiveness of western coal as an energy resource. Each of these involves a complex range of implementation strategies and will not be elaborated in this section. It should be emphasized that rail transport depends on a strip-and-ship policy which, in turn, would be consistent with western opposition to conversion facilities such as power plants. If western conversion is promoted, HVTL's or pipelines rather than railroads would be transporting energy from the West.

As a competitor for rail shipment of raw coal, coal slurry pipelines are the primary threat to rail monopoly. The alternative of promoting slurries is evaluated in a later section; this section considers expansion of rail lines into new areas (such as Four Corners) and double-track routes as an enhancement of rail capacity. Federal assistance may be desirable in order to allow production and shipment of western energy from previously inaccessible areas. An enlarged investment tax credit to 20 percent for railroad expansion is a possible implementation strategy that could reduce the tremendous inertia against rail expansion.

On the subject of rail freight rates, the price of transporting coal by rail is affected by year-to-year contracts between utilities (or other consumers) and railroad companies. Rate schedules are posted with the ICC, and subject to policies specified in legislation summarized in Section 11.2. The 4-R Act of 1976[1] permits new flexibility in rates which are negotiated between a railroad and a utility. Intervention in establishing rates must be initiated by proponents of reduced rates in order to convene a hearing to review tariffs. Under present ICC policies rail carriers can impose rates above cost on one commodity (such as coal) to offset losses on other routes or commodities. In locations where alternative modes do not exist (such as in many southwestern locations) this is an effective method to enhance the capital-forming capability of the railroads. In other locations, such as along routes paralleling inland waterways maintained by the federal government, barge competition may preclude this option.

The economic stability of railroads can be maintained through other economic and regulatory policies. Economic policies include federal loans, federal assurance for repayment of obligations such as bonds, or outright purchase of stock issues by a government fund.[2] Regulatory policies include permitting railroads to make long-term contracts with shippers for movement of coal.[3] Standard rate agreements may extend for a maximum of one year, but the 4-R Act includes a provision allowing rates to be established for a five-year period without change where an investment in transportation equipment of more than $1 million is made.

Federal loans have been a major source of funds for railroads, especially financially ailing lines needing improved equipment. In addition, loan guarantees have been made to rail lines in western states, both for equipment acquisition and for track rehabilitation.[4] However, western lines, such as Burlington Northern and Union Pacific, are generally less eligible for these programs than weaker eastern railroads. Policies to enhance economic stability of railroads could also provide expedited mechanisms for route discontinuance. By permitting service reductions on some routes the overall financial capability of railroads can be improved.

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[1] Railroad Revitilization and Regulatory Reform Act of 1976, Pub. L. 94-210, 90 Stat. 31.

[2] Provisions such as these are included in the 4-R Act of 1976, (Ibid.).

[3] The ICC is currently developing policies to permit long-term contracts on a case-by-case basis. "Information Letter." Association of American Railroads, May 25, 1978, p. 2.

[4] "U.S. to Back Railroad Loan." Wall Street Journal, May 31, 1978, p. 19.

In addition, in the case of some western locations, no rail service is presently available (such as in the coal fields of the San Juan Basin in northwestern New Mexico). For these types of locations, subsidy of new track may be needed to provide rail service for coal export as well as for economic development of the region.

B. Mitigate Adverse Impact of Unit Trains

There are a number of things that can be done to reduce the adverse consequences of increased rail transportation of coal on communities along the railway. These include improvements in safety and access across railroad lines, such as (1) installing or improving grade crossing safety signals; (2) constructing grade separations; and (3) constructing by-pass rail lines around some communities. Noise impacts from rail traffic can be dealt with by other alternatives, such as (1) constructing noise barriers along the right-of-way in sensitive areas; (2) reducing noise emissions from trains; and (3) revising land-use plans along railroad rights-of-way, taking into account increased coal train traffic.

The safety and access impacts of coal transportation affect all communities along a rail route. Safety signals at certain crossings might reduce accident risk, especially in towns where traffic is heavy. Rural signalization is generally not considered a serious option because of costs. Most towns will need to have access for emergency vehicles and general traffic; this need will increase as rail coal shipments increase. Construction of grade separations (over- and underpasses) in larger towns is already perceived as a need, and may become a major issue in smaller towns as a result of western energy development. Finally, by-pass lines around larger cities would largely avoid the crossing problem as well as noise problems, and would permit somewhat higher train speeds. By-passes around smaller communities or construction of major new sections of main line by-passing several towns are other possible options.

Noise reduction alternatives include improving the engineering design of locomotives, coal cars, or tracks; alternatives that primarily would require additional research and are not short-term options. Reducing train speeds would reduce noise somewhat, but would exacerbate traffic and access problems. Noise barriers, to be effective, must extend significantly above the noise source, notably the locomotive exhaust outlet. Building barriers, lowering tracks, and planting trees are possibilities in this area. Land-use plans could prevent future urban activities from locating near railroad tracks, thereby reducing noise received. Finally, grade separations also mitigate the noise problem by obviating the need for hornblowing.

A particular implementation strategy that could address several of these policy alternatives is to establish a task force at the state level, consisting of representatives of, for example, the state transportation or highway department, the railroad firms operating in the state, local governments, and appropriate federal agencies, such as the ICC. This task force would undertake planning studies, based on projected levels of coal transport, to determine the level of community impacts and to establish priorities for actions to mitigate these impacts.[1] For example, the task force would identify crossings where improved safety signals or grade separations are justified and may identify communities where the rerouting of tracks or the construction of noise barriers is desirable. The lead agency, usually the state transportation department, would then carry out the recommendations of the task force. The financial resources required could come from such sources as state highway funds, railroad companies, and federal funds made available through federal highway programs or the 4-R Act of 1976. In addition, for those states with significant levels of coal production, some portions of state severance taxes on coal could be set aside for these purposes.

In carrying out its planning and evaluation function, the task force would consider the costs and benefits of the safety and noise policies in order to determine priorities among and within affected communities and to compare the alternative mitigation measures. It should be noted that it probably would not be practical for the task force to undertake implementation of noise mitigation. The reduction in noise emissions from trains would probably best be dealt with through a uniform national standard, while the land-use planning process would remain in the hands of the local governmental units. However, the task force could make recommendations to the appropriate federal agencies on noise standards and could assist local governments with revisions of land-use plans.

C. Promote Coal Slurry Pipelines

Granting eminent domain at the federal level is the specific policy option considered here, rather than the granting through individual states. The ICC would need to certify public convenience and necessity, but the usual obligations of common carriage seem to be excluded from the controls on slurries, as discussed earlier. This alternative directly addresses the objective of increasing energy transport capacity, doing so by an expansion in the number of energy transport modes available.

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[1] An example of this type of planning study is one for Colorado funded by the Four Corners Regional Commission: URS Company. Coal Train Assessment, Final Report for Colorado Department of Highways. Denver, Colo.: URS, 1976.

D. Minimize Impacts of High Voltage Transmission Lines

Three quite different options are considered that would reduce the impacts of high-voltage electricity transmission. The first is to reduce the level of voltage that can be used to a ceiling below which certain adverse impacts are minimal (e.g., 350-400 kV). The determination of the level would be an important part of the implementation of this alternative, since conflicts over the increased costs of utilizing lower voltage versus the hazards of higher voltage make the capacity ceiling problematical. A second alternative is to expand research on alternatives to AC transmission, especially DC transmission. Since most of the impacts of high-voltage transmission are a consequence of the nature of AC, the impacts should tend to be avoided with this alternative. Finally, institution of interstate planning for transmission line routes could address interstate conflicts over routing, width of right-of-way, and other aspects of HVTL's. In part, this alternative is included within the more detailed discussion of facility siting found in Chapter 12.

E. Summary of Description of Alternatives

The alternatives discussed above can be applied separately or in combination by a range of public and private policymakers. Many of the policies involve decisions by industry to reduce impacts while expanding transport capacity. These decisions, of course, will be influenced by government regulations, incentives, and other policies. In other cases, the initiative will generally rest with governments (federal, state, and local), which influence the actions of the private sector through incentives, regulations, and other policies.

11.3.3 Evaluation of Alternatives

A. Evaluation Criteria

The five basic evaluation criteria identified and defined in Chapter 3 are used in the evaluation and comparison of policy alternatives in this section. Table 11-14 defines these criteria as they apply to this category of problems and issues and lists the qualitative and quantitative measures which are used. As shown in Table 11-14, applying these criteria raises questions which relate to the substantive features of each alternative as well as those which address the political concerns of the policy options.

Each of the four categories of policy alternatives is evaluated in this section according to these criteria. A summary evaluation will follow the discussion of each policy category.

TABLE 11-14: EVALUATIVE CRITERIA

CRITERIA	AS APPLIED TO TRANSPORTATION	MEASURES
Effectiveness Is the policy objective achieved?	How much transportation capacity is added? How soon can new transportation capacity be added? Will bottlenecks in energy flows from the West be reduced? How much physical and socioeconomic impact will there be?	Possibility of increasing capacity Success in reducing impacts
Efficiency Costs, risks, and benefits Economic	What are the economic costs of increasing transportation capacity? What are the financial risks with alternative strategies? Will regional development be stimulated?	Effect on costs of energy Costs of implementation Reduces environmental risks
Environmental	What is the cost to other uses of land and resources? What is the degree of environmental risk? Are environmental values, such as aesthetics, degraded? How much water is consumed?	
Equity Distribution of costs, risks, and benefits Geographic	What are the costs and impacts of these transportation facilities on different regions or areas? What are the effects of these facilities on: (a) landowners; (b) communities through which the facilities pass; (c) residents along the route? What are the benefits to consuming areas as compared to impacts in producing areas?	Consumer and industry interests Western communities interests Agricultural interests

TABLE 11-14: (Continued)

CRITERIA	AS APPLIED TO TRANSPORTATION	MEASURES
Equity (continued)		
Sectoral	Who benefits in communities through which transportation facilities pass? How much do operators have to pay compared with their benefits?	
Flexibility		
Adaptable to locational needs and changes over time	Do the alternatives allow for different conditions or implementation strategies at different locations? Is it reversible or irreversible? Will the alternative be able to be modified over time to adjust to different needs? Does the alternative accommodate unique needs of different people?	Low capital costs Adjustable to changing conditions Adjustable to different locations
Implementability		
Possibility of being implemented	Will changes in legislation be required or can the alternatives be implemented within existing laws and institutions? Will it be opposed to strong interests? How strongly will stakeholders respond? Will it threaten established institutions? Are western values of independence, populism, and states' rights accommodated?	New laws or regulations required? Opposed by powerful groups?

B. Evaluation of Enhancing Rail Capacity

(1) Is the Alternative Effective?

Several studies have assessed the capacity of western railroads to meet future coal transportation demands,[1] and the consensus generally is that railroads will be physically able to acquire the necessary rolling stock and maintain or upgrade track capacity to meet expected needs (e.g., 345 million tons per year of western coal production is projected by 1985 in the National Energy Plan). One factor working in the railroads' favor in financing these capacity increases is that they can be added more quickly than a new mine can be opened or a new power plant built. Thus, uncertainty over the general financial requirements for upgrading railway capacity will not be a critical factor since investment capital can be sought on an ad hoc, as-needed basis.[2]

However, investment needs for the necessary improvements are anticipated to be about $8 billion.[3] Since this is considerably above the recent annual level of capital outlays[4] the policy options being considered (increasing the flexibility of long-term contracts, flexible pricing, and enhancing government subsidy of railroads) are probably necessary to assure adequate western coal transportation capacity.

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[1] For example see Manalytics, Inc. Coal Transportation Capacity of the Existing Rail and Barge Network, 1985 and Beyond. Palo Alto, Calif.: Electric Power Research Institute, n.d., p. 6; and Richard J. Barber Associates. The Railroads, Coal and the National Energy Plan: An Assessment of the Issue. Washington, D.C.: Richard J. Barber Associates, 1977, p. 37. As cited in U.S., Congress, Senate, Committee on Energy and Natural Resources, and Committee on Commerce, Science, and Transportation. National Energy Transportation, Vol. III: Issues and Problems, Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977, pp. 461-63.

[2] Barber Associates. Railroads, Coal, and NEP. As cited in Senate Committees on Energy and Natural Resources, and Commerce, Science, and Transportation. National Energy Transportation, Vol. III, p. 464.

[3] Senate Committees on Energy and Natural Resources, and Commerce, Science, and Transportation. National Energy Transportation, Vol. III, p. 463.

[4] Barber Associates. Railroads, Coal, and NEP. As cited in Senate Committees on Energy and Natural Resources, and Commerce, Science, and Transportation. National Energy Transportation, Vol. III, p. 465.

In addition, although it is expected that overall rail capacity can be made sufficient to meet demands, there are cases where rail routes are not serving some important energy producing areas, such as the San Juan Basin in northwestern New Mexico and the associated cities of Farmington, Aztec, Bloomfield, and Shiprock. It is unlikely that rail service will be effectively provided for these areas without substantial government subsidy, including provisions that make new investment attractive, such as the proposed 20 percent investment tax credit for railroads.[1] The new 110-mile rail line to coal fields near Gillette, Wyoming, is the first major extension of national rail service in 70 years.

A major problem in increasing reliance on rail transportation is interruption in service due to strikes and accidents. Strikes can affect some or all routes for weeks or months at a time, which can cause severe problems for coal users if the back-up supply is depleted. Generally, however, rail strikes pose a smaller threat to coal supply than do strikes of coal miners. Train derailments can also interrupt service for up to a week, but typically only two or three days. These short-term interruptions generally have not affected utilities or other coal users.

(2) How Are Costs and Benefits Affected?

A major factor affecting the desirability of expanding coal transportation by rail is economic and environmental costs. The environmental costs are discussed under the alternative of mitigating adverse environmental impacts from rail transportation. This section focuses primarily on economic costs, emphasizing costs for shipment by unit train to utilities near demand centers.

One factor affecting the ability to evaluate and manage coal shipment rates is difficulty in obtaining an understanding of how to calculate actual costs and compare these with "reasonable rates." Tariff information may be published annually or at other times; costs differ according to volume, points of origin, car size, train type, and type of delivery location such as docks, ports, or utilities. Defining "cost," therefore, is a difficult regulatory process. There are significant fixed costs (such as roadbed), but no uniformly agreed basis for apportioning that cost to the various classes of service. Consequently, it becomes difficult to define "discrimination" or excessive costs. As a result of these factors, the Congressional Research Service and the ICC have indicated the need for "revised uniform terminology" in tariff schedules to understand their feasibility and degree of controversy, and to facilitate the regulatory process.

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[1] Testimony by Association of American Railroads Staff before U.S. Senate Finance Committee, August 23, 1978; reported in "Rails Asking for Billions in Subsidies." Denver Post, August 25, 1978.

Railroads might be more competitive and stable if permitted to make binding long-term rate agreements with shippers of coal. Long-term rates might permit savings to the railroad from greater certainty of traffic and administrative ease. The problems raised with long-term rate agreements are equity among shippers, among railroads, and among modes, as well as the changes that would be necessary in the regulatory or statutory framework, including that governing coal slurry pipelines, discussed below.

However, railroads may not be interested in long-term fixed rates as long as they can adjust rates to meet their financial needs. Both the railroad and the shipper would be "locking themselves in" over the term of the contract. The railroad might miscalculate its advancing costs of inflation, labor, and maintenance, or might fail to provide for them adequately by contractual clauses which index rates to such variables.[1] The shipper, on the other hand, would preclude his own use of other transportation options, such as slurry pipelines, or might be unable to participate in the benefits of general rate reductions of the railroad.[2]

There are other, less direct, links between western economic interests and railroads' coal hauling activities. First, railroads employ about 4.8 employees per million tons of coal per 100 miles and a total of nearly 30,000 in the western states (Table 11-15). Railroads also carry assessed property valuations of 20 cents per annual ton of capacity along rail routes. These tax revenues (for which comprehensive data are not available) will accrue mostly to county governments.

(3) How Are Costs and Benefits Distributed?

Many of the conflicts associated with transportation problems deal with problems of equity among shippers, the transportation sector, and the general public. These equity problems are associated primarily with routes and rate structure (i.e., how costs are distributed).

An underlying problem in evaluating transportation inequities is the incremental and commodity-specific orientation of transportation policies. In addition, each mode has major economic costs redistributed in different ways. Water-borne commerce, for example, is subsidized through government built and maintained inland waterways systems. Truck and auto traffic is serviced by a

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[1] U.S., Congress, Senate, Committee on Energy and Natural Resources, and Committee on Commerce, Science, and Transportation. National Energy Transportation, Vol. III: Issues and Problems, Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977, p. 479.

[2] Ibid.

TABLE 11-15: RAILROAD EMPLOYMENT IN WESTERN STATES, 1976

STATE	RAILROAD EMPLOYEES
Arizona	3,460
Colorado	5,710
Montana	5,820
New Mexico	2,840
North Dakota	2,900
South Dakota	1,130
Utah	4,750
Wyoming	3,090
Total	29,700

Source: American Association of Railroads. Yearbook of Railroad Facts, 1976. Washington, D.C.: AAR, 1976, p. 60.

government owned and maintained surface road system that pays no property taxes. The economic effect of these kinds of cost redistribution is difficult to document. But the patterns that emerge characterize transportation policies as overt political trade-offs among competitive modes and routes. This pattern of cost redistribution is due to the difficulty in achieving an integrated and comprehensive transportation policy. The evaluation of equity becomes highly judgmental, often reflecting attitudes about which industrial groups, routes, services, and patterns of subsidy best serve the public and the national interest.

Current procedures intensify equity conflicts by permitting rates in excess of costs for many western coal routes.[1] The alternative described here, allowing more flexibility for railroads, contributes to this conflict so that consumers served by coal-fired utilities or other end users subsidize the rail industry and also benefit shippers and consumers of noncoal commodities. Implementation strategies that diminish shipper (e.g., electric utility) subsidies in favor of government subsidies, including loans, grants, and tax incentives, would spread costs over a larger general public. If increased use of western coal is a desired national goal benefiting the general public, then government subsidies may distribute increased capital needs more equitably than using coal shipment as a means to subsidize other commodities and routes, such as grain shipment or the movement of industrial goods. However, this type of government implementation strategy might conflict with the railroad's interest in achieving a more independent industry.[1]

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[1] Drew, Christopher. "Texas Battle of Coal Hauling Rates Risks U.S. Energy Plan, Efforts Lift Rail Net." Wall Street Journal, June 17, 1978, p. 19.

The western industries which are most dependent on rail service are agriculture, forestry, and mining. Assuring adequate financial capacity for railroads could protect the interests of these users in terms of track availability, routes, and rates as discussed below.

Track availability. While an increased volume of coal unit trains could cause delays for other classes of freight, it is also possible that roadbed and signaling improvements as well as double-tracking will become more widespread in response to coal traffic, making for better all-around service. In a few cases, new routes will be opened, cutting perhaps hundreds of miles off of shipping distances.[2] However, coal shipments along some routes are likely to compete for cars, engines, and schedules with existing passenger and freight transportation, placing these at a disadvantage. The extent of this disruption is uncertain and is difficult to predict.

Routes. Also important for the regional economy would be provisions that currently operative rail lines will not be abandoned. Concern over rail abandonment in the northeastern states played an important role in shaping the 4-R Act in 1976. Low-use routes are common in the West, as pointed out in Section 11.2.2.A. If flexibility is granted the western railroads in terms of reduced exit restrictions, some areas may lose rail service.

Rates. One of the serious concerns which has kept long-term rate agreements from being a policy option in the past is the possible effects on shippers other than the one who had the agreement.[1] A main purpose of railroad and common carrier regulation is to prevent discrimination among shippers.[2] Of course, if the railroad offered the same rate to any shipper for a given volume, term, and distance, unfairness would be reduced.[3]

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[1] U.S., Congress, Senate, Committee on Energy and Natural Resources, and Committee on Commerce, Science, and Transportation. National Energy Transportation, Vol. III: Issues and Problems, Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977, p. 466.

[2] For example, Burlington Northern and Chicago & Northwestern are planning a 113-mile line from Gillette to Douglas, Wyoming, connecting the mainlines of those two railroad companies. U.S., Department of the Interior, Bureau of Land Management. Final Environmental Impact Statement, Eastern Powder River Coal Basin of Wyoming. Washington, D.C.: U.S., Department of Interior, 1974, Vol. V, map 12.

In addition, coal as a commodity is more susceptible to long-term contracting in all phases than most goods. Coal supplies a continuing steady demand, which generally is not subject to the wide seasonal or yearly variations typical of many other bulk commodities (e.g., grain). Therefore, allowing long-term rates for coal movement and not for all other materials shipped by rail could be justifiable.[4]

On the other hand, long-term contracts may reduce competition among railroads by preventing the shipper from switching his traffic to another line for the term of the contract. It is possible that one railroad could use contract rates to lock up the traffic in a given area to which another railroad would desire to extend or improve service.

(4) Are the Alternatives Flexible?

The policy alternative of increasing the economic capability of railroads enhances flexibility in coal transportation. It can provide more hopper cars to serve more routes and locations, and enhances the capability of existing track to speed service to a greater number of customers. Rolling stock is the most flexible capital investment; however, commitments to track also enhance a system's ability to service multiple customers in a variety of locations. Added track does represent a fixed commitment for service, however, and abandonment of service to communities or industry is frequently resisted by the public and regulatory agencies.

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[1] U.S., Congress, Senate, Committee on Energy and Natural Resources, and Committee on Commerce, Science, and Transportation. National Energy Transportation, Vol. III: Issues and Problems, Committee Print, by the Congressional Research Service. Washington, D.C.: Government Printing Office, 1977, p. 480.

[2] U.S. Railway Association. "Intermodal and Intramodal Competition," in MacAvoy, Paul, and John Snow, eds. Railroad Revitalization and Regulatory Reform. Washington, D.C.: American Enterprise Institute, 1977, pp. 54-55; and Friedlander, Ann. The Dilemma of Freight Transport Regulation. Washington, D.C.: Brookings Institution, 1969.

[3] Senate Committees on Energy and Natural Resources, and Commerce, Science, and Transportation. National Energy Transportation, Vol. III, p. 481.

[4] Ibid.

Enhanced economic capability of railroads does not per se reduce options to utilize other transportation modes. Competition with other modes (truck, slurry, barge) may be enhanced to the benefit of shippers using other modes if a strong rail mode competition exists.

Among the possible implementation options, some government subsidy programs may be the most flexible alternatives, and long-term unit train contracts are the least flexible because they are contract specific. Tax incentives on capital investment are flexible policy choices that do not commit the railroads to a fixed plan or set of services. Likewise, grants, or loan subsidies can be implemented to meet specific short- or midterm needs. However, significant commitments to improve railroads by government subsidy could tend to become a nearly irreversible policy commitment to public support for a major private sector activity.

(5) Can the Alternatives Be Implemented?

Allowing special, lower rates for coal transport based on lot size to facilitate large shipments is considered by the ICC as "personal discrimination" and has not often been accepted.[1] Also if railroad flexibility were implemented in terms of routes and services, it would include allowing line abandonments. While a need for flexibility by railroads may be generally recognized, no one is eager to see service terminated for their particular community or commodity.[2] In short, some means of attaining economic stability for railroads go against several traditions, values, and interests.

On the other hand, enhanced government subsidies have a long record of widespread acceptance by the public. However, the railroads would apparently desire private sector funding by achieving a better rate of return on investments, rather than simply receiving loans or loan guarantees.

The railroads also have been active in seeking preferential investment tax credits. Significant historical record exists for a variety of such government subsidy policies, and these could be specifically tailored to meet the needs of transporting western energy resources. However these policies of government subsidy have received increasing criticism from tax-conscious segments of government and the public. It is possible that continued subsidies of the railroads will become less acceptable in the future.

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[1] "The Eastern Rail Disease Spreads to the Midwest." Business Week, January 23, 1978, pp. 79-80.

[2] "Transportation: The Reins Loosen." Business Week, April 4, 1977, p. 93.

C. Evaluation of Mitigating Unit Train Impacts

(1) How Effective Are the Various Mitigation Measures?

The overall effectiveness of such a policy alternative would depend on the effectiveness of each specific mitigation measure (e.g., grade separations or noise barriers) and on the total amount of funding that could be made available for the program. The costs and possible funding sources are discussed later. In the following, the degree to which the individual mitigation measures can reduce the community impacts of unit trains is briefly discussed.

It is clear that the most effective measure of the specific policy alternatives is to construct by-pass rail lines for unit trains (and other "nonstop" traffic). This simply removes the source of the problem. Of course, some of the problems, such as safety hazards at grade crossings, would be transferred to the new route but, assuming road traffic is less and fewer towns are divided, then the overall impact would be less. Grade separations could be provided along the new route at roads with significant traffic levels.

Since most communities would probably not want to give up their existing rail service, issues concerning line abandonment discussed under the previous alternatives also are raised here. Especially in certain cities which rely heavily on rail service, it might be necessary for the railroads to maintain existing lines through those communities.

The upgrading of safety devices at grade crossings would reduce, but not eliminate the hazards for pedestrian and vehicular traffic but would do nothing for the "barrier" effect or access problems created by a high volume of train traffic. Construction of grade separations for the major traffic arteries in a community would effectively eliminate both of these problems.

Two measures were identified for dealing with noise: construct noise barriers (such as berms, walls, or vegetation) and reduce emission levels from trains. An obvious possible way to control noise from this source is to reduce train speeds, but these are already limited in most communities to 20 or 30 miles per hour. Also, this would do nothing to control the major noise source, locomotives, and reducing the speed even further would exacerbate the traffic congestion problem. According to EPA standards, locomotives manufactured after 1979 must meet a standard of 90 dBA at 100 feet. Thus, as newer locomotives are brought into service and older ones phased out, noise problems will be reduced. Whether noise emission levels could practicably be reduced even further is unknown. The other alternative is to construct noise barriers. To be effective, however, such noise barriers must extend significantly above the noise source, the major one being the locomotive exhaust outlet. One study shows that barriers as high as five-story buildings or more are required to lower noise levels below 80 dBA for locomotives at 100 feet.[1] Constructing barriers this high or lowering tracks this much would not only be expensive but also might be physically impossible to accomplish within existing rights-of-way, especially in towns. Thick stands of trees will also provide some noise barrier effect, but this would be difficult to accomplish in many of the arid western regions and sufficiently wide rights-of-way do not exist in many western communities. In summary, one study concluded that there was little that could be done to reduce noise impacts in sensitive areas near the tracks other than either relocating the tracks or the receptors (people).[2]

The final measure considered in this policy category is the revision of land-use plans in communities, taking into account projected increases in train traffic. This measure is not aimed so much at ameliorating existing impacts but rather at preventing future ones as towns expand and grow. A particular zoning designation for an area of land near the railway might have been compatible with railroad operations during a period of low traffic volume, but it might be incompatible with higher train traffic levels where noise and access become more significant. Such areas might therefore be rezoned to a classification, such as agricultural or heavy industrial, that would not be incompatible with nearby high-volume railway operations. Existing land uses are not changed by this policy, so that only future impacts are addressed.

Finally, it should be noted that while the set of measures considered here is aimed at reducing the adverse community impacts of coal train transport, some might also incrementally contribute to the first part of the policy objective, namely, increasing western coal transportation capacity. For example, the rerouting of unit trains around communities and the construction of grade separations might allow unit trains to travel faster and thus reach their destinations more quickly. While overall capacity of a railway route is a complex function of the number of locomotives, cars, and track available and the average speed allowed, generally as average speed increases, the capacity of the route should increase.

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[1] Wyle Laboratories. Assessment of Noise Environments Around Railroad Operations, Report WCR 73-5. N.p., 1973. As cited in URS Company. Coal Train Assessment, Final Report for Colorado Department of Highways. Denver, Colo.: URS, 1976, p. VII-49.

[2] URS. Coal Train Assessment, p. VII-49.

(2) What Are the Economic Costs of This Alternative?

There are very few data available on the costs of implementing the various measures identified; also, the costs for some will be highly dependent on site-specific factors. It has been estimated that grade crossing protection can cost up to $70,000 per crossing, while the construction of grade separations generally ranges from $750,000 to $1.5 million, depending on conditions. To give some idea of total cost magnitude, there are 167 grade crossings in urban areas in Colorado alone. To construct grade separations for each of these crossings would cost from $125 to $250 million.[1]

No data are available on the cost of constructing berms or walls to act as noise barriers, but, as noted previously, it is considered to be extremely expensive.[2] With respect to reducing emission levels from locomotives, EPA has estimated that to meet the new standards required for locomotives manufactured in 1979 (90 dBA at 100 feet) will not in itself be sufficient to necessitate increases in rates.[3]

The cost of constructing by-pass routes around communities will depend very much on the routes available and the land values near the community. One source indicated that a typical cost for constructing new double-tracks is $500,000 per mile.[4] Thus, to construct a by-pass [illegible] 15 miles could be expected to cost on the order of $7.5 milli[illegible] Besides these direct costs, this measure also creates a number of other important costs and benefits for the community. Land values along the new route, land-use plans, and community growth patterns can all be substantially altered by the construction of a new rail line. Conversely, if an existing rail line were abandoned, there would be other community effects. On the one hand, the removal of the rail line through a central business district could allow for community redevelopment programs and could raise property values along the old right-of-way. On the other hand, loss or lowering of rail service could have a disruptive effect on some businesses and require the relocations of some rail-dependent industries. The importance of rail service to a town and its industries must be determined on an individual basis, and trade-offs will certainly be necessary.

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[1] URS Company. Coal Train Assessment, Final Report for Colorado Department of Highways. Denver, Colo.: URS, 1976, pp. VII-20 and VII-12.

[2] Ibid., p. VII-49.

[3] Ibid., p. V-8.

[4] U.S., Congress, Office of Technology Assessment, Coal Slurry Pipeline Project Staff. A Technology Assessment of Coal Slurry Pipelines, Prepublication Draft. Washington, D.C.: Office of Technology Assessment, 1978.

The costs of implementing the task force and carrying out the required planning studies would be relatively small compared to the costs of implementing the various impact mitigation measures, but they would not be insignificant. No firm data are available, but assuming the majority of task force members would be contributed by their employers, the task force could probably be operated (including contracted planning studies) for a cost of $150,000 to $400,000 per year. After the initial planning studies were completed, costs could drop significantly.

(3) How Are Costs and Benefits Distributed?

The primary beneficiaries of impact mitigation policies will be the residents of communities through which coal train traffic passes and the motoring public more generally. If rail capacity is also improved, end consumers of the energy and the nation more broadly will benefit from the increased domestic energy supply, while the railroads may derive some direct benefits from some of the measures through increased railway capacity.

The sharing of costs necessary to implement the various impact mitigation measures is dependent upon how the program is structured. There are four general sources of funds to carry out this program: state highway or general revenue funds; railroads; local government sources; and federal funds.

Most states currently spend some state highway funds to upgrade highway/railroad crossings but the amounts currently being spent are probably inadequate to address the problem effectively. Local governments also could finance some portion of these costs but their resources are usually quite limited, as emphasized in Chapter 9. In Colorado, the Public Utilities Commission's Railroad-Highway Grade Crossing Protection Fund receives $20,000 per month from the Highway User Trust Fund to be used for the upgrading or installation of grade crossing protection. This fund is used only in cases where no federal funding is available; the railroad must pay a minimum of 10 percent, based on the benefit to the railroad, with the remaining cost divided between the county or city that owns the roadway and the fund.[1] Not only are the total dollar amounts quite limited, but the funds cannot be used for the full spectrum of alternative measures being considered in this policy option.

An attractive means for financing such a program in states with substantial coal development is to use some portion of state severance taxes on coal production. This is an equitable approach since it in effect passes these impact mitigation costs on to the energy consumers. Of course, this approach would not be possible for those noncoal producing states that lie on the major coal transportation routes from the West to coal consuming areas.

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[1] URS Company. Coal Train Assessment, Final Report for Colorado Department of Highways. Denver, Colo.: URS, 1976, p. VIII-12.

It would seem that to be equitable, railroads should also pay for some portion of the costs for the impact mitigation measures, at least in proportion to the direct benefits that they would receive. However, this would have to be handled on a case-by-case basis and would require a "goodwill," cooperative attitude on the part of the individual railroad companies. There appears to be no way under most existing state laws that railroads could be forced to participate in the cost sharing. Given the competitive nature of the industry, the financial condition of many railroads, and past experiences with some companies, there are reasons to expect that overall the railroad industry would pay for only a small fraction of the total impact mitigation costs.

As happens in so many other cases of this type, the federal government would probably be required to finance the major share of the costs for this policy alternative. There are three possible means for making these funds available: federal highway funds; federal funding for railroad industry improvements; and special appropriations specifically for this purpose. The Federal Highway Act of 1976 does provide for funding of rail-highway safety projects. This act represents a major change in federal policy in that it allows federal financing for crossing safety projects on all public streets and roads, not just those on the Federal Aid Highway System. In addition, funding can be used to finance track relocation demonstration projects in urban areas.[1] The level of funding for these projects was $200 million for fiscal year 1977, which is a small amount compared to the magnitude of the needs associated with western energy development. For example, Colorado's share of these funds amounted to $2,755,000 in fiscal 1977. The legislation also carries a stipulation that at least one-half of the Federal Aid Highway System monies be used for installation of signal devices at rail-highway crossings, which seriously limits the availability of funds for grade separation projects.[2]

Another possible source of federal funds for railroad improvements is made available through the 4-R Act of 1976. However, railroad companies are eligible to apply for funds under the Act only if they were unable to raise the funds in normal money markets.[3] One study noted that railroads operating in Colorado (Union Pacific, Burlington Northern, Santa Fe, and Rio Grande) were relatively prosperous compared to many others in the industry and thus will likely be ineligible to receive funds under the Act.[1] The Act may also provide funds to government entities to be used for railway improvement and rehabilitation, including projects concerned with highway-rail safety.

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[1] URS Company. Coal Train Assesment, Final Report for Colorado Department of Highways. Denver, Colo.: URS, 1976, p. VII-11.

[2] Ibid., p. VII-12.

[3] Ibid.

A third possible avenue for federal financing of such a program is special appropriations specifically for this purpose. One such bill was recently introduced in Congress but was not passed (see box). One group who might oppose such a program is slurry pipeline interests who might view the public expenditure of funds to mitigate railroad impacts as inequitable. They could argue that slurry pipelines could be constructed without public financial support and not create the adverse community impacts caused by unit trains.

GRADE CROSSING BILL MAKES PROGRESS

A bill has been approved by a U.S. House subcommittee to provide $200 million to help states build railroad overpasses and underpasses in areas where heavy coal traffic exists. Representative Jim Johnson, R-Colo., who introduced the bill, noted that at least 20 Colorado highway crossings of railroads would qualify for the federal construction money. The bill is now being considered by the House Public Works and Transportation Committee.

--Parmenter, Cindy. "House Unit Passes Rail Overpass Bill." Denver Post, May 5, 1978.

(4) Is the Alternative Flexible?

This policy alternative would rank high on the basis of flexibility. It proposes no across-the-board approach. Rather, the establishment of a task force within each state, made up of representatives of all affected groups, would set goals and priorities among competing projects based on the perceived needs within that state and the availability of funds. Thus the program is easily adjustable to different locations and to changing conditions.

(5) How Difficult Will It Be to Implement the Alternative?

The initial program could be easily established by the administrative branch of state government. No new legislation would be necessary to initiate the task force and the planning studies. The main obstacle at this point would be the budgeting of funds required for the task force operation and the planning studies.

The ultimate effectiveness of the program will, of course, depend on the amount of funds available to carry out the measures recommended by the task force. As noted, these measures can be expensive and presently there do not appear to be any existing programs at the state or federal level to finance the full range of improvements at the level likely to be needed. It is this aspect of the policy alternative that will be the most difficult to implement since new federal and/or state funding programs may be required.

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[1] URS Company. Coal Train Assessment, Final Report for Colorado Department of Highways. Denver, Colo.: URS, 1976, pp. VIII-12 and 13.

D. Evaluation of Coal Slurry Pipeline Promotion

(1) Will Coal Transportation Capacity Be Enhanced?

Coal slurry pipelines could feasibly transport a portion of western coal to demand centers if construction is not blocked by the lack of eminent domain powers and if sufficient water (or other transport medium) is made available. This alternative, therefore, may be effective for increasing the capacity for transporting western coal outside the region by removing one of the obstacles, lack of eminent domain powers. The reliability of the supply of western coal to the nation also will be increased because disrupted service on one mode, such as a rail strike, will not directly affect the other mode.

Adequate capacity in supplier industries and capital markets is available to expand both slurry pipelines and rail systems faster than coal mining or coal-fired power plants can be expanded. The choice of either mode will not be limited by capacity, but by cost and demand. The demand for coal slurry pipelines will depend on national coal demand growth rates, environmental regulations, and transportation costs. For example, a strict definition of best available control technology coupled with high slurry transportation costs would tend to reduce the demand for western coal and the use of coal slurry pipelines.

While the extensive use of coal slurry pipelines will probably not greatly affect the national use of coal and the rate of coal development, it will probably increase the rate of development and use of western coal. Granting coal slurry pipelines, which are most economical for long distance shipments, the right of eminent domain will probably allow western coal to be transported economically farther outside the region than if just rail transport of coal is used. This could result in a slightly reduced growth rate in the development of midwestern and eastern coal, and a reduction in railroad revenue.[1]

(2) What Are the Costs and Benefits?

Under at least some circumstances, coal slurry pipelines can transport coal at lower cost than any other coal transport mode. Coal slurry pipelines are particularly attractive when supplying mines are large and closely spaced, high annual volumes of coal are shipped over long distances, real interest rates are low in light of anticipated rates of inflation, terrain is favorable, sufficient water is available at low cost, rail operations are inefficient or needing upgrading, there is no parallel navigable waterway, and there is a secure long-term market for the coal. In short, coal slurry pipelines involve high capital costs and relatively low operating costs compared to railroads which are subject to higher operating costs and the effects of wage inflation. These conditions generally are met for western coal, with two possible exceptions: western coal-hauling railroads are among the most efficient and well-maintained in the country; and the availability of water is open to serious question, especially in Wyoming, the origin of most planned slurry lines. Overall economic efficiency in coal transportation probably would be obtained by a combination of rail and slurry pipelines for coal shipments, despite opposition from rails to any penetration by slurries into the coal-hauling business.

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[1] U.S., Congress, Office of Technology Assessment, Coal Slurry Pipeline Project Staff. A Technology Assessment of Coal Slurry Pipelines, Prepublication Draft. Washington, D.C.: Office of Technology Assessment, 1978, p. 75.

The larger issue is over the environmental effects of both modes. Water use by slurries is not as large as some mine-mouth conversion of coal, as indicated in Section 11.2.2, but is more visible, as it leaves the state and the region in a pipeline rather than in the form of vapor from power plant cooling towers. However, raw coal for burning or conversion at a demand center can be shipped either by rail or by slurry, and railroads require essentially no water. Temporary construction impacts of slurry lines will tend to be larger-scale than any likely construction of new railroad track, but neither are considered severe. These construction impacts of slurries include land disruption, as land is cleared and trenches are dug, and socioeconomic effects, as the construction force moves along the route as construction proceeds. This large, temporary construction employment is contrasted with the larger and more stable employment in the railroads.

Operation impacts appear to be greater from rail transport, including noise, land-use disruption, accidents at crossings, and other safety and access problems discussed earlier. Slurries, on the other hand, will generally be underground. Slurries will require excavation if plugs or breaks should occur, as discussed earlier. Rail operating impacts may be relatively greater but have been around for a long time and are better understood, whereas slurry impacts will be completely new.

(3) How Are Costs and Benefits Distributed?

If coal slurry pipelines are given the right of eminent domain while regulations on railroads are not relaxed, coal pipelines would have a significant regulatory advantage. Probably the major disadvantage that the railroads would bear is their inability to enter into long-term contracts.[1] Precedent exists for eminent domain in the 1947 Amendment to the Natural Gas Act, which gave similar authority to gas pipelines. Most oil and fertilizer pipelines have been built only between states with state-level eminent domain authority.[2]

Coal slurry development in the West will probably result in reduced revenues in the future for western railroads and more competition between the two modes. While overall coal transport costs will probably be reduced, the costs of shipping items other than coal by rail will be increased. It has been estimated that if pipelines took 45 percent of the western coal ton-miles by the year 2000, western railroads would have to raise their rates to all other shippers by from 4.0 to 4.7 percent (over levels in the absence of slurries) to maintain a constant level of profitability.[3] However, this point does not take into account efficiency improvements stimulated by the increased competition and it could also be interpreted to mean that rail rates would simply decline less if slurries are allowed to compete rather than there being an increase in rates compared to the current situation.

Coal slurry pipelines are favored by some in the West who believe tax revenues will be increased by their development. In Colorado, for example, some legislators have predicted that, by allowing slurry pipelines to run through the state, from $2 to $3 million in taxes will be gained by the state. However, the same legislators did not want Colorado water to be used.[4]

The method by which coal slurry pipelines obtain water can significantly affect the distribution of costs. The Central Utah Project, which is projected to cost approximately $1 billion, is aimed at providing more water for energy development needs (mainly coal conversion) and will be funded by the public with the costs of this development to be passed on to or recouped from water users.[5] On the other hand, coal slurry operators are likely to be required to pay the expenses of obtaining their own water supply, such as developing the necessary well supply system.[1] This would result in a more direct internalization of water costs than would the public construction of water projects.

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[1] U.S., Congress, Office of Technology Assessment, Coal Slurry Pipeline Project Staff. A Technology Assessment of Coal Slurry Pipelines, Prepublication Draft. Washington, D.C.: Office of Technology Assessment, 1978, p. 3.

[2] Ibid., pp. 22-23.

[3] Ibid., Section V.

[4] "It's Coal Slurry Pipeline Water That Worries Lawmakers." Wyoming State Tribune, December 20, 1977.

[5] Wynkoop, Steve. "Diversion of Water for Energy Studied." Denver Post, December 16, 1976.

(4) Is the Policy Flexible?

Granting coal slurry pipelines the right of eminent domain will provide a choice of modes for exporting coal from the West. Under the current regulatory context, in most cases coal must either be exported by rail or converted to another energy form before being transmitted outside the region. Giving large coal users a choice will increase competition and flexibility in transporting coal. The nation will not be limited to one transport mode which may be subject to labor disputes and other problems.

Coal slurry pipelines do not have the flexibility in economic shipping capacity that railroads do. Flow velocity cannot be varied greatly and the delivery of slurry must continue during shut-down periods at the receiving power plant. Both routing and the types of commodities slurry pipelines can carry are inflexible compared to railroads.[2]

Granting coal slurry pipelines eminent domain at the federal level will preempt the states from granting or denying this right in response to local political conditions. This would be a reduction in flexibility in regulating slurry pipelines, and may be subject to differing interpretations in the courts.

(5) Are There Barriers to Implementation?

This alternative as analyzed here would involve federal action although there are other implementation strategies under which coal slurry pipelines could be developed. Some proposals have already been made before the U.S. Congress to grant coal slurry pipelines the right of eminent domain, and a precedent for granting such a right exists in the 1947 Amendment to the Natural Gas Act, which gave similar authority to interstate natural gas pipelines.

As noted earlier, railroads have joined with agricultural interests in opposition to the development of coal slurry pipelines in the West, each for different reasons. National labor unions have also voiced opposition to slurry pipelines. For example, the Railway Labor Executives Association of the AFL-CIO opposes granting slurry pipelines the right of eminent domain, fearing it may cost railroad jobs.[1] The United Mine Workers opposes slurries because they may make it easier to transport nonunion western coal into eastern markets during strikes, thus weakening the union's bargaining position.[2]

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[1] Strain, Peggy. "Water, Land, Life--It's All One in Valley Pipeline Debate." Denver Post, November 13, 1977, pp. 3, 15.

[2] Murray, Francis X., ed. Where We Agree: Report of the National Coal Policy Project. Boulder, Colo.: Westview Press, 1978, pp. 42-43.

A major reservation to slurry legislation in Congress concerns water requirements for the pipelines and the availability of western water for agricultural, municipal, and other needs. The states have particularly focused on the water issue in their opposition. In May, Wyoming Governor Ed Herschler testified against slurry pipelines before the Senate Energy Committee: "If Wyoming is to continue to play a substantial role in fulfilling the nation's energy demands, then our water must be kept available for uses in the state of Wyoming, and not shipped to other states."[3]

In 1977, the Colorado General Assembly approved legislation to prohibit temporarily the export of water from the state in coal slurry pipelines.[4] Slurry interests note that the pipelines require about a ton of water for each ton of coal, while energy conversion facilities require more water to process the same amount of coal (this is discussed is more detail in Section 11.2.2). Other states, such as Utah, seem to be unopposed to use of water for energy development. Utah plans to divert water for energy uses despite opposition from agricultural interests.[5]

Railroads are perhaps the major barrier to the implementation of proslurry alternatives. Railroads note that their lines are presently underutilized and that slurry pipelines would cut into the most profitable and convenient hauls, those shipping large volumes of material from point to point over long distances. As noted by the president of the AAR in testimony before the House Interior Committee: "This is the 'cream' of the coal traffic... that would be 'skimmed' by the pipeline operators, while railroads--as true common carriers--would be required to provide service to all."[1]

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[1] Corrigan, Richard. "Railroads Versus Coal Pipelines--New Showdown in the West." National Journal, Vol. 8 (March 6, 1976), p. 294.

[2] Ibid., p. 295.

[3] Bureau of National Affairs. "DOE Assures State Rights in Coal Slurry Lines; Bill Goes to Floor." Energy Users Report, Current Report No. 249 (May 18, 1978), p. 21.

[4] "It's Coal Slurry Pipeline Water That Worries Lawmakers." Wyoming State Tribune, December 20, 1977.

[5] Wynkoop, Steve. "Diversion of Water for Energy Studied." Denver Post, December 15, 1976.

Thus, considerable opposition to slurries exists, which threatens their wide use as a coal transport mode. On the other side of the issue are public utilities which need coal for power generation, the National Coal Association, consumers who prefer low-cost means of coal transport in order to keep rates low, and federal energy planners who see slurries as an aid to expanded western coal production. The conflict will not easily be resolved, and some experimentation with a large-scale, long-distance slurry pipeline might help to make cost comparisons possible.

E. Evaluation of Reducing High Voltage Transmission Line Impacts

(1) How Effective Will the Policy Be?

As discussed in Section 11.2.2 and illustrated in Table 11-8, there are considerable economic advantages to higher voltage AC transmission, but these also are associated with larger impacts. Regulation of the voltage to a maximum of, for example, 600 kV would reduce the corona and electric shock effects on humans and wildlife in their vicinity. This advantage is countered with a corresponding need for a greater number of HVTL's in order to transmit the same amount of power at the lower voltage capacity. The cost impacts of this trade-off are considered under efficiency.

Increased research on technological alternatives to AC transmission lines could focus on the DC option. Since DC has few of the electric field effects of AC, adverse impacts would be minimized for new lines using DC technology. Under present technological capabilities, DC is not an alternative to AC for short-distance, distribution-oriented transmission. Increased research and development (R&D) effort to reduce the cost of terminal facilities could bring about improvements in that capability to match DC's superiority in long-distance, point-to-point transmission.

The choice of routes for HVTL's, especially across state boundaries, has considerable bearing on the impacts of the transportation mode. Interstate differences in the control of transmission line rights-of-way siting create problems each time a new set of transmission lines is built. Interstate planning would not necessarily increase transmission capacity, but it might produce design and route selection decisions which minimize adverse impacts.

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[1] Corrigan, Richard. "Railroads Versus Coal Pipelines--New Showdown in the West." National Journal, Vol. 8 (March 8, 1976), p. 293.

(2) What Are the Costs and Benefits and How Are They Distributed?

Setting a maximum limit on HVTL voltage would directly affect the costs of AC transmission. Lower voltage means more transmission lines, and correspondingly higher costs for land, materials, and construction. As Table 11-8 indicated, 500 kV lines would cost $4 billion (36 percent) more than 765 kV lines transmitting the same amount of electricity (51,000 MWe) over 1,000 miles. These higher costs would be borne by the customers of the power system. The benefit in reduced health and safety impacts also would be countered by the greater environmental damage associated with the right-of-way and construction. These impacts, like those of health and safety, affect populations along the length of the transmission lines.

Increased research on DC transmission to remove technological uncertainties and to make them economically more attractive will require considerable expenditures by both the electric power industry and the federal government. For example, in 1977 the federal government spent approximately $11 million for underground and overhead DC transmission research while the Electric Power Research Institute (EPRI) allocated $9.7 million for research on overhead DC lines and $7.2 million for underground lines.[1] If the research is successful, electric utilities and their customers will benefit from the availability of the more efficient options while residents along transmission lines will benefit since many impacts along DC lines would be less than with AC. Some impacts however, such as telephone interference, may be worse than with AC. The benefit of such R&D would, of course, only benefit future HVTL's, not those lines existing or constructed in the near future. Thus, this is primarily a long-term option, with benefits to be received mainly after considerable R&D expenditure is made.

The costs and benefits of improved planning and siting procedures are difficult to quantify. As emphasized in Chapter 12, the implementation of well-represented planning and siting mechanisms increases the input of interested parties, with the intention of decreasing opposition to the resulting agreement. That is, the goal is to reach decisions which equitably distribute the costs and benefits. Utilities (and their customers) may also benefit from greater certainty and fewer delays in the siting process.

(3) Are the Alternatives Flexible and Implementable?

A single maximum voltage for all HVTL's in a state would not be a flexible alternative compared to the existing situation in which there are no standards and utilities are free to choose the optimal voltage for their transmission lines subject to state agency approval. Because of the restrictions imposed, utilities could be expected to oppose such an approach. In addition, consumer groups could be allied to counter increased electric rates due to greater costs for lower-voltage HVTL's. The trade-off is of the health and safety of residents near the transmission lines versus the economic considerations of utilities and their customers.

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[1] Kash, Don E., et al. Our Energy Future: The Role of Research, Development, and Demonstration in Reaching a National Consensus on Energy Supply. Norman, Okla.: University of Oklahoma Press, 1976.

A research, development, and demonstration program on DC transmission would increase flexibility by creating an alternative to AC. This approach would be easy to implement through both existing research conducted at the EPRI and the programs supported by the Department of Energy. Little opposition would be likely, except in choices such as the priorities for research and levels of funding. This is also an area of research which could benefit from international cooperation since electric power transmission is a problem common to all countries regardless of their primary energy resources.

Interstate planning of HVTL's will reduce the flexibility states now have in HVTL siting procedures since it will require a concensus with neighboring states. Also, any significant changes in siting procedures could be perceived as decreasing the flexibility of electric utilities. For these reasons, formalized interstate HVTL siting procedures will likely be difficult to implement.

11.3.4 Summary Evaluation

Table 11-16 lists features of each of the four categories of policy alternatives in terms of the evaluative criteria. A comparison of the alternatives, especially in effectiveness, is not warranted because of their diversity. The first and third options are aimed primarily at increasing capacity while the other two are concerned primarily with impact mitigation. In terms of equity, railroads and electric utilities probably would be harmed relative to other industries, through higher mandatory costs. An exception is the enhanced rail capacity options which would, in effect, subsidize rail expansion in the West.

The highest flexibility would probably result from combinations of all the alternatives. Railroads and slurries could share responsibility (and profits) for coal shipments. Both railroad and HVTL impacts are in need of mitigation measures. The principal difference between them is that rail impacts are localized at a number of sites (including towns and rural crossings), and mitigation can be handled in a "piecemeal" fashion at individual sites. HVTL impacts are more uniform along the entire length of a line, precluding piecemeal solutions. If trends to reduce federal expenditures remain in effect, several alternatives could be hindered, especially subsidies for rail expansion, grade separation projects,

TABLE 11-16: SUMMARY EVALUATION OF TRANSPORTATION POLICY ALTERNATIVES

CRITERIA	ENHANCE RAIL CAPACITY	MITIGATE UNIT-TRAIN IMPACTS	COAL SLURRY PIPELINES	MITIGATE HVTL IMPACTS
Effectiveness	May be required to finance needed capacity expansion. Risks of increased reliance on railroads due to strikes.	Grade separations and rerouting both would help access. Noise impacts will be difficult to reduce without rerouting.	Slurries represent an alternative coal transport mode and could allow increased coal production. Water use concerns could still block slurries.	Impacts will be reduced by all three options, but no direct effects on capacity are evident. Increased R&D on DC transmissions is long-term option.
Efficiency Economic costs and benefits	Rates may rise or government subsidies increase. Financial stability to railroads. Employment benefits. Capacity improvements will be available for nonenergy shippers.	Cost of $750,000 to $1.5 million per grade separation, and $500,000 per mile for new track. Town planning could improve.	Slurry costs are lower than rail. Some state-level tax benefits would result. Railroads' financial strength will be lessened.	Voltage limits reduce impacts, but with considerable increase in costs and land use. Risk that increased R&D on DC transmission may not pay off. Utilities, consumers, and residents could benefit from R&D. Planning procedures will be least expensive.
Equity	Coal rates could subsidize other commodities. Increased flexibility could result in loss of service for some communities.	State severance tax funding would pass costs to energy consumers. Railroads would pay only voluntarily. Federal funding would be most abundant for grade separation construction.	Rail profits may decline.	Benefits of lower voltage accrue to those in vicinity of HVTL's; costs will be borne by consumers. Utilities may gain more certainty from interstate planning.

TABLE 11-16: (Continued)

CRITERIA	ENHANCE RAIL CAPACITY	MITIGATE UNIT-TRAIN IMPACTS	COAL SLURRY PIPELINES	MITIGATE HVTL IMPACTS
Flexibility	Would help railroads' competitiveness with other modes. Long-term contracts are inherently inflexible. Subsidy programs are often irreversible.	State-level task force implementation is very flexible because of local interests represented.	Slurries are a less flexible transport mode in routing and commodity types. Federal legislation would preempt state decisions over eminent domain.	Voltage regulation would not be flexible. R&D would increase options available for HVTL's.
Implementability	Subsidies are increasingly unpopular and would be resisted. Rail abandonment would be strongly resisted.	State-level activities have relatively few obstacles, but federal funding may be harder to implement.	Legal precedent exists for federal control. Considerable opposition to slurries from states, railroads, and agriculture threatens slurries as a widely-used alternative.	Utilities would oppose voltage limits, but would probably favor increased R&D. Consumer groups might be opposed to voltage limits because of higher electric bills which would be likely.

HVTL = high voltage transmission lines

R&D = research and development

DC = direct current

and possibly even R&D. In that situation, industry would have to bear a greater share of the cost of impact mitigation, and energy consumers would pay rather than taxpayers generally.

CHAPTER 12

ENERGY FACILITY SITING

EXECUTIVE SUMMARY

Facility siting policies will largely determine both the kind and level of impacts resulting from energy resource development in the West; thus, they have increasingly become the focus of controversies about the distribution of costs, risks, and benefits of energy development. Attempts to reduce impacts through the siting process are constrained by current federal, state, and local facility siting laws and regulations, which are fragmented, uncoordinated, and often in direct conflict.

Impacts

Locational characteristics, which help to determine impacts in the West include: local topography; climate; background air pollution levels; dispersal potential; proximity to pristine areas; water availability; community size and location; local economic, historical, cultural, financial, and political conditions; and plant and animal community characteristics. Characteristics of technologies which determine impacts at a given site include: labor and capital intensiveness, emission quantities, land and water requirements, and construction and operation scheduling.

Coal conversion technologies produce the most air, water, and socioeconomic impacts in the West, while surface mining of coal produces the greatest land-related impacts. However, the extent of all these coal impacts varies considerably with location. Of the resources studied, oil shale is the most geographically concentrated, allowing the least amount of locational flexibility with regard to impacts. Uranium and geothermal resources in the West are also more concentrated than coal and conversion facilities must be located near to the resource.

The identification of critical technological and locational factors is a key aspect of our study, since many consequences could be minimized if the most suitable combination of technology and location is chosen. Hence, baseline knowledge about technological and locational characteristics can be a critical element in energy facility siting decisionmaking.

The Policy Context

No comprehensive federal or regional siting policy exists, and few states in the West have attempted to develop an overall siting process. Thus, siting decisions are usually fragmented, not coordinated with related choices about energy development, and subject to long delays. Thus, inadequate attention is given to technology-location combinations which can be used to reduce many of the impacts of development.

Among the most important factors influencing siting processes are the following:

- Federal and state environmental legislation restricts where development can occur, helps to define how facilities will be configured, and requires lengthy and uncertain review processes.
- Public participation has opened siting decisions to more diverse interests. Environmental interest groups have been the most visible of these "new" participants; but agricultural groups, coalitions of ranchers, Indians, and other parties-at-interest have become important participants in siting.
- Intergovernmental disputes increasingly influence siting, since western facilities largely serve demands outside the region. Many western states have adopted restrictive siting laws in order to reduce resource exploitation by outside interests, while others have actively tried to encourage development. Federal court cases, regional voting blocs in Congress, a variety of interstate conflicts, and federal-state disputes help to shape western siting decisions.

These factors, along with the inherent importance of siting, have created a complex policymaking system which is essentially out of the control of developers, federal agencies, or the state and local interests which face the most direct consequences of energy resource development. Because the facility siting system has seldom been successful in balancing the variety of interests at stake, many interest groups resort to a variety of tactics to delay or cancel projects. As a result, it has become virtually impossible to anticipate when, where, and at what level development will occur, and these uncertainties directly contribute to the inability of local and state governments to manage development impacts and growth.

Alternative Policies

These issues suggest that two policy objectives will be important to facility siting: site energy facilities in locations which will result in the most acceptable mix of costs, risks, and benefits; and provide better ways for interest group involvement without unacceptable delays. As shown in Table 12ES-1, several alternatives exist for achieving these objectives.

TABLE 12ES-1: FACILITY SITING ALTERNATIVES

OBJECTIVE	CATEGORY OF ALTERNATIVES	SPECIFIC ALTERNATIVES
Site energy facilities in locations which will result in the most acceptable mix of costs, risks, and benefits.	Technology-site evaluations	Designate acceptable and unacceptable technology-location combinations Implement site screening and site banking techniques
	Impact assistance	Require impact mitigation by developers, state or federal governments Compensate state and local governments for impacts
Provide the means for interested parties to participate in siting decisions without causing unreasonable delays	Increase citizen involvement in siting decision-making	Provide for information exchange between participants and agencies Encourage administrative interaction between agencies and participants Allow direct participant input into agency decisions
	Provide participation process support	Provide technical or financial assistance for participants

The site selection process can be improved by choosing acceptable combinations of technologies and locations, including site-screening and site banking, by requiring impact assistance to state and local governments, or by compensating adversely impacted groups. Access to siting can be increased by encouraging information exchange and interaction, by allowing direct participant input into agency decisions, and by providing technical or financial assistance for parties-at-interest.

Findings

Siting is among the most critical components of energy policymaking since it is an occasion at which most of the important questions and issues of resource development come together. However, there is very little to suggest that the current siting system can possibly convert these diverse values into reasonable policies, and, in many respects, it represents fragmented, incremental decisionmaking *ad absurdum*.

The value of technology site evaluations is that they could provide something the present siting system has very little of--comprehensive consideration of relative advantages and disadvantages of various siting strategies. While this could never remove all of the uncertainties associated with energy development, it could present the opportunity to improve significantly the information base in the siting process. In particular, technology-site evaluations provide a means to reduce the risks of energy development by removing from consideration areas where opposition is most widespread.

While the success of technology-site evaluations partially depends on the quality and timeliness of information produced, success will also require more fundamental changes in the system. The most important of these appear to be equitable access to decisionmaking by parties-at-interest *in combination with* limits on how long and in what manner siting decisions can continue to be contested after review processes are over. This does not imply that our knowledge of energy development technologies and locational factors is advanced enough to predict, once and for all, the consequences of development. It does suggest that, if issues are given a fair hearing, stricter limits should be placed on how they can be appealed. This approach to siting will probably lengthen, rather than shorten, the initial processes in order for various interests to be expressed. However, it could shorten the total time required to bring a facility on line, and could also reduce some of the uncertainty associated with facility siting.

However, perhaps not even these revisions will improve the siting process. In the end, "reasonable" determinations of where to locate energy development facilities may depend on the willingness of parties-at-interest to recognize the legitimacy of other values. If participants are not able to reach compromises over competing interests, the major alternative approaches appear to be either to accept the uncertainties, inequities and, at times, paralysis, of the existing system or to adopt more centralized and controllable policymaking institutions.

CHAPTER 12

ENERGY FACILITY SITING

12.1 INTRODUCTION

Since the impacts of energy resource development are heavily dependent on the type of energy technology chosen and the location at which the technology is deployed, siting policies will largely determine what impacts actually occur when western energy resources are developed. Facility siting is the process which matches an energy supply technology, such as a power plant or mine, with a specific location. Through siting, the overall impacts of energy development can be affected by the manner in which the technology is linked to the characteristics of the location. For example, siting water-intensive facilities (such as steam-electric power plants) in a water-short area (such as the Upper Colorado River Basin) is likely to intensify water availability problems and spur conflicts over water rights. Likewise, siting energy conversion facilities near national parks or other clean air areas will increase the likelihood of conflicts over air quality. Because of these kinds of interrelationships, an analysis of siting necessarily draws upon the analyses described in the previous eight chapters.

Since energy development begins with facility siting, siting decisions often become the focus of a broader controversy over how the costs and benefits of development should be distributed. Siting energy conversion facilities in the West and developing western energy resources has already led to major interregional and interstate conflicts. A developing rivalry between energy-rich western states and energy-consuming eastern states is particularly significant.[1] Other problems arise because laws and regulations governing facility siting often are uncoordinated and overlapping among and between levels of government. At the federal level, no single agency has the responsibility for looking at the overall need for a major energy facility from the viewpoint of the long range public interest,[1] and federal siting activities are often inconsistent with state programs. In fact, for siting policy, "the gap between federal and state jurisdiction remains something of an institutional no man's land."[2] As a result, those siting laws and regulations which are intended to mitigate the impacts of energy facilities often do so in a fragmented, redundant manner. Many siting issues are resolved only on a permit-by-permit basis. For example, the licensing process for a coal-fired power plant may involve up to 50 separate permits, each requiring different public hearings and legal findings.[3] When combined with the conflicts among participants with different interests who disagree on the trade-offs between the benefits and costs of energy development, these characteristics lead to delays in siting new energy facilities.

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[1] Lamm, Richard D. "States Rights Vs. National Energy Needs." Natural Resources Lawyer, Vol. 9 (No. 1, 1976), pp. 41-48.

This chapter addresses the problems and issues of siting specific energy facilities in the West. In general, it will evaluate alternative strategies of siting energy facilities throughout the West to achieve certain economic and energy production goals while protecting the environmental quality of the region. One regional siting strategy, for example, is to export coal for conversion in facilities sited at or near metropolitan demand centers. This would eliminate many population-related and environmental impacts of energy development in the West, such as boomtowns and land-use problems.[4] For the most part, siting coal facilities outside the region is a way to avoid all facility-related impacts in the West except those associated with mining. Most of the land-use impacts mentioned in Chapter 7 would still occur in a "strip and ship" coal export strategy as would the water quality impacts cited in Chapter 4 resulting from aquifer interruption in surface mining. The transportation impacts identified in Chapter 12 would also tend to be greater if coal was exported. However, most of the benefits (such as higher levels of employment and an increased tax base) of western energy development[1] would either be greatly reduced or eliminated by a facility siting pattern that emphasized coal use outside the region.

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[1] Van Dyke, Hubert. "The Federal Perspective," in Kloman, Erasmus, ed. The Federal System and Energy Facility Siting. Washington, D.C.: National Academy of Public Administration, 1977, p. 38.

[2] Zeni, L.E. "The State Perspective," in Kloman. Energy Facility Siting, pp. 9-21.

[3] Calvert, J.R. "Licensing Coal-Fired Power Plants." Power Engineering, Vol. 82 (January 1978), p. 34.

[4] Metzger, James E., and Erik V. Stenehjem. "An Analysis of the Socioeconomic Impacts of Alternative Siting Patterns: Minemouth Versus Remote Electrical Generation." Paper presented at the 70th Annual Meeting of the Air Pollution Control Association, Toronto, Ontario, Canada, June 20-24, 1977.

In national terms, moving coal conversion facilities from our eight-state study area to other areas (primarily the Midwest, South, and West Coast) would simply redistribute the impacts. For example, air pollution issues concerning ambient air quality and emission controls (see Chapter 6) would be transferred to other regions, raising a host of policy questions, such as increased health hazards for larger population concentrations and possibly higher pollution control costs. Air quality considerations near major cities are already forcing the selection of rural sites for energy facilities serving metropolitan energy demands. These rural sites still are often within the commuting area for skilled labor, so that population-related impacts are greatly reduced.[2] Water availability, while less of a problem outside the West, can also constrain siting and the extent of energy development in the interior and eastern regions of the nation.[3]

Although the adverse impacts in the West clearly would be lessened by shipping coal to conversion plants sited in other regions, the consequences of developing other energy resources would still remain. Within the West, impacts will still occur as oil shale, gas, uranium, and geothermal energy are developed. With the important exception of oil shale, these impacts generally will be smaller in magnitude than those from coal. Further, because of the concentrated location of oil shale, those impacts will affect a relatively small portion of the region, primarily western Colorado and eastern Utah.

Intermediate siting strategies--that is, locating facilities between the mine-mouth and demand-centers--could include energy parks or clusters of facilities, or development could follow a more dispersed pattern which avoids siting concentrations. Through these strategies, various impacts could be reduced. For example, more water may be available at an intermediate site than either at or near a mine or demand site. And the availability of a work force in a larger town can lessen the population-related impacts of development. However, if a strategy of concentrating facilities is followed, air quality and most other physical impacts would be greater. A strategy to disperse or spread energy facilities around the West[1] would reduce the magnitude of many impacts, although at considerable expense if locations near major resource areas were not used. However, the concentration of some resources (particularly oil shale) would make this strategy difficult to implement. Depending on site characteristics, dispersing energy facilities would tend to mitigate boomtown effects, lower the magnitude of air, water, and ecological impacts, and lessen the burden on limited water supplies. On the other hand, increased transportation facilities would be needed to serve a greater number of sites, with a corresponding increase in impacts.

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[1] White, Irvin, L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[2] See Westinghouse Electric Corporation, Envrionmental Systems Department. Socioeconomic Impact of Power Generation: A Planning Study. Pittsburgh, Pa.: Westinghouse Electric Corporation, 1977; and Shurcliff, A.W. "The Local Economic Impact of Nuclear Power." Technology Review, Vol. 79 (January 1977), pp. 40-48.

[3] Van Kuiken, J.C., et al. Long-Term Siting Patterns for Major Electrical and Coal Conversion Facilities. Argonne, Ill.: Argonne National Laboratory, 1977.

The remainder of this chapter is divided into two major sections. The first describes energy facility siting choices as well as a description of the social and political context of siting issues in the West. The second section focuses on alternative policies for energy facility siting. Included in this section are descriptions, assessments, and comparisons of two categories of policy alternatives: those which enable the siting of energy facilities in locations which will not result in unacceptable costs and risks, including technology-site evaluation and impact assistance; and those which provide the means for participants to facilitate siting decisions without unreasonable delays, including increasing citizen involvement and participation process support.

12.2 ENERGY FACILITY SITING PROBLEMS AND ISSUES

12.2.1 Siting Impacts of Energy Resource Development

Since energy facility siting involves choosing the location for energy technologies, knowledge of the locational and technological factors affecting impacts are central to the siting process. Matching technologies to locations through the siting process involves such considerations as the resource requirements and residuals for each technology. These form the basis for making environmental-economic-energy trade-offs and restrict the locational flexibility of energy facilities. For example, water intensive facilities, such as coal liquefaction projects and power plants configured to use wet cooling, will be more restricted by water availability than coal gasification will be. By comparing the resource requirements and residuals of the technologies to the distribution of requisite resources, the availability of potentially acceptable sites can be determined. As this implies, the location and characteristics of energy resources are equally significant. Feasible sites for a given technology are constrained by the distribution of resources. Thus, the fact that oil shale occurs in only a small portion of western Colorado, eastern Utah, and southwestern Wyoming is a major constraint on oil shale resource development. These kinds of data should be part of the knowledge base available to policymakers. Therefore, the discussion below briefly outlines the critical technological and locational factors that can be taken into account in energy facility siting decisions.

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[1] This strategy is similar to the "smaller dispersed facilities" option discussed for air quality in Chapter 6.

[2] Dickson, E.M., et al. Synthetic Liquid Fuels Development: Assessment of Critical Factors, Vol. III. Menlo Park, Calif.: Stanford Research Institute, 1977.

The facility siting process encompasses all of the categories of impacts from energy development discussed in the preceding chapters. The impacts resulting from the deployment of energy technologies at various locations have been identified in our Energy From the West: Impact Analysis Report.[1] Specific impacts discussed in the preceding chapters will not be described here. However, in order to illustrate the range of technological and locational factors which may alter the impacts of energy development, the most significant of these factors are outlined in Table 12-1. As this table indicates, there are a number of air quality, water availability and quality, socioeconomic, and ecological factors which, taken individually or in combination, may be manipulated by policymakers to influence the pattern or scale of impacts.

A. Technological Factors

The technological factors associated with energy development vary considerably with the technology chosen. Labor intensiveness (or personnel requirements) affects all four categories of impacts studied. A larger population results in higher automobile emissions, a need for more water and an increased sewage treatment capability, a wider variety of culture and lifestyles, and greater land-use infringement on the surrounding wildlife habitat. Water requirements have an effect on ecosystems which depend on instream flow and wetland availability; for electric power generation, these water requirements depend on the type of cooling. Both the quality and type of air emissions and water effluents also generate ecological impacts.

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[1] See White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

TABLE 12-1: TECHNOLOGICAL AND LOCATIONAL FACTORS AFFECTING ENERGY DEVELOPMENT IMPACTS[a]

FACTORS	AIR QUALITY	WATER AVAILABILITY AND QUALITY	SOCIOECONOMIC	ECOLOGICAL
Technological	Emission quantities Labor intensiveness	Water requirements Labor intensiveness Amount and composition of effluents Type of cooling	Labor intensity Capital intensity Scheduling of construction	Land requirements Water requirements Labor intensity Air emissions
Locational	Energy resource characteristics Meteorological conditions Topography Nearness to Class I PSD areas	Water availability Water quality Energy resource characteristics Aquifer characteristics Capacity of existing wastewater treatment facilities	Community size and location Capabilities of existing institutions Historical outmigration Local labor force characteristics Local financial conditions Culture and lifestyles of the area	Climate Topography Soils Plant and animal communities

PSD = Prevention of Significant Deterioration

Source: White, Irvin L., *et al*. *Energy From the West: Impact Analysis Report*. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[a] Several sets of factors would be involved in large-scale developments that include more than one technology, such as a coal mine and a power plant at the same site.

In general, the impacts associated with oil shale and coal conversion technologies are greater than with extraction technologies. The principal exceptions are land use, particulate emissions and, in some cases, water availability impacts. Among the coal conversion technologies, on a unit of energy output basis, electric power generation produces the most air impacts and uses the largest quantities of land and water. Surface oil shale processing (the TOSCO II process) produces the most liquid effluent, followed by Synthoil coal liquefaction. Coal gasification and liquefaction require the largest work forces and, consequently, result in the greatest population-related impacts.

B. Locational Factors

As indicated in Table 12-1, locational charcteristics which influence the level of impacts include: local topography, air pollution dispersion potential, background levels of air pollutants, meteorological conditions, proximity of the site to pristine areas such as national parks, community size and location, available work force, characteristics of local economy, characteristics of the resources, water availability and quality, and plant and animal communities.

The importance of the locational characteristics in influencing the severity and distribution of impacts has been described in the other chapters in this report. For instance, in the analyses of housing and local facilities and services (Chapters 8 and 9), it is emphasized that the size of a community before the construction phase of development determines to a large extent the level of population impact. Small towns generally have limited planning capabilities and inadequate public facilities and services. Siting energy facilities near larger towns (population 10,000 or larger) can help overcome these limitations.

As was mentioned above, the physical location of a resource may be a primary obstacle to development. Similarly, the heating value or other chemical characteristics can limit the attractiveness of a resource base. Thus the sulfur content of coal, which varies substantially within the West, renders some resource locations more favorable for development than others. The choice of location for facilities that export their product in a raw form (e.g., coal, oil, and gas) tends to respond to the availability of high-quality and low-cost resources. Thus, the thick seams of low-sulfur coal in the Powder River Basin area surrounding Gillette, Wyoming, have attracted a dozen large surface mine operations.[1] On the other hand, energy conversion facilities (synthetic gas, electricity, and hydrocarbon liquids) tend to be constrained by market-area and distribution systems factors. For example, utilities in California and the Southwest generally do not consider Northern Great Plains coal; likewise, the coal gasification proposals for North Dakota are intended for nearby Midwestern markets.[1]

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[1] "Wyoming Grassland Transformed to Coal Mining Center." Civil Engineering--ASCE, Vol. 47 (September 1977), pp. 50-56.

The air and water impacts resulting from energy development vary with other locational characteristics. Air impacts depend critically on local meteorology, topography, existing air quality, and the nearness of Class I Prevention of Significant Deterioration (PSD) areas. Water impacts differ with the amount and quality of available water, including both surface and groundwater. Air and water impacts can be reduced by siting energy conversion facilities in areas with the most favorable conditions. However, for resources like oil shale this is not always technically possible, and in some cases, locational choices are constrained by energy transportation cost considerations.[2]

12.2.2 The Context of Facility Siting Issues in the West

Since there is now no comprehensive national siting strategy, decisionmaking authority in energy facility siting is often fragmented, parochial, and reactive in nature. As a result, policymakers in this system often lack the capability to balance economic, energy, and environmental trade-offs in determining "best-fit" sites for new energy facilities. Nor is it easy, given the fragmented policy system, to determine which sites should be avoided or which are the critical impact-causing factors. Moreover, the siting process has inherent redundancies which, when coupled with interest group intervention, can delay the decisions regarding the siting of new facilities. The siting process is characterized by the involvement of many different interests and authorities representing a diversity of viewpoints, and possessing limited information.

This section of the chapter briefly describes the current site selection process and how decisions are made concerning the acceptability of a proposed site. The manner in which this process has evolved over time and the efforts which have been made to change it are also briefly described.

Although the initial determination of the need for and location of new facilities is usually made by energy industries, their decisions are shaped and modified by public policy. As Russell E. Train, the former Administrator of the Environmental Protection Agency (EPA) noted, the present siting process is a purely "reactive" system in which industry selects the sites and the state and federal regulatory agencies respond to permit requests.[1]

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[1] Corsentino, J.S. Projects to Expand Fuel Sources in Western States: Survey of Planned or Proposed Coal, Oil Shale, Tar Sands, Uranium, and Geothermal Supply Expansion Projects, and Related Infrastructure, in States West of the Mississippi River (as of May 1976), Bureau of Mines Information Circular 8719. Washington, D.C.: Government Printing Office, 1976.

[2] See Chapter 11, Energy Transportation, on this point.

Utilities and other energy companies engage in system planning which constantly assesses their system needs. As shown in Table 12-2, important aspects of system planning that influence siting decisions for utilities are: load forecasting, generator selection, reliability analyses, territorial considerations, corporate policy, and economics.[2] Government agencies and public interest groups generally are not active in the early planning stages for new energy facilities. Once a firm's system planning indicates that additional demands for energy will develop, several options are open to the company in addition to acquiring sites for new facilities. For example, an electric utility may be able to expand or replace units on existing sites, or it may choose to purchase power from other sources.

Considerable controversy surrounds the determination of need for new energy supply, and it is at this point in the siting process that governmental and other interested participants become involved. Opponents of utilities maintain that firms purposely engage in capacity-increasing projects for self-serving reasons. On the other hand, questioning energy need has been termed a deliberate tactic used by obstructionists to delay new energy projects.[3] In any case, delays do result; Robert I. Hanfling, the Acting Director of Utility Projects for the Department of Energy (DOE), notes that conflict over the need for new energy facilities is one of the major problems in getting projects completed on schedule.[4] Indeed, Montana Power Company's application for two additional power plants at Colstrip, Montana, was denied

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[1] Carter, Luther J. "Virginia Refinery Battle: Another Dilemma in Energy Facility Siting." Science, Vol. 199 (February 10, 1978), p. 671.

[2] Cirillo, Richard R., et al. An Evaluation of Regional Trends in Power Plant Siting and Energy Transportation. Argonne, Ill.: Argonne National Laboratory, 1976, p. 5. This table and the discussion in this section apply primarily to electric utilities, but they also relate to activities by other energy firms.

[3] See Sayre, Kenneth M. Values in the Electric Power Industry. South Bend, Ind.: University of Notre Dame Press, 1977, for a more detailed examination of the different perceptions of how the determinations of need for new energy are made by utilities.

[4] Cavanaugh, H.A. "Utility Decisions: What Voice for the Public?" Electrical World, Vol. 188 (December 15, 1977), p. 89.

TABLE 12-2: IMPORTANT CRITERIA IN MAKING SITING DECISIONS FOR UTILITIES

SYSTEM PLANNING	
CRITERIA	DESCRIPTION
Load Forecasting	Estimates of system demand (the need for electricity at any point in time) and the geographical distribution of the load.
Generator Selection	Choice of energy source (fossil, nuclear, hydro, etc.), and plant size.
Reliability Analysis	Study of the impact of plant location, size, type, transmission interconnections, and timing on system stability.
Territorial Considerations	Defining the region of interest and candidate areas for plant location.
Corporate Policy	For example, share of capacity met by each energy source.
Economics	Fiscal and other economic inputs to corporate decisions; for example, capital availability.
SITE-SPECIFIC EVALUATIONS	
Engineering	Availability of adequate land area, sufficient cooling water, construction materials, and labor, suitability of foundation conditions, favorability of topography, accessibility of transportation facilities, and general plant and transmission line layout requirements.
Safety	Effects of accidents on the surrounding area and effects of the location and risks of accidents (e.g., earthquakes).
Environmental	Impacts of a site on the physical environment, land use and regional development, and socioeconomic patterns.
Institutional	Regulations applicable for the area in which the plant is being located.
Economic	Comparisons among alternative technologies and sites in terms of capital costs, operating costs, and rate of return.

Source: Adapted from Cirillo, Richard R., et al. An Evaluation of Regional Trends in Power Plant Siting and Energy Transportation. Argonne, Ill.: Argonne National Laboratory, 1976, pp. 8-14.

by the Montana Department of Natural Resources and Conservation largely because the need for new facilities in Montana was not adequately established. Most of the electricity from the proposed Colstrip units was to be exported to Pacific Coast states.[1]

Once the need for new energy facilities has been established, and assuming the utility decides to locate facilities on new sites, a screening process usually identifies several prospective sites for additional analysis. As indicated in Table 12-2, the most significant criteria used in evaluating the specific sites are engineering, safety, environmental, institutional, and economic considerations.[2] Although the utility's system planning and site selection process must consider how the proposal conforms to federal, state, and local requirements, the utility's plans are largely proprietary and not subject to public inspection. Historically, once the utility persuaded the state utility commission and the Federal Power Commission (FPC) that a new facility was needed and that the project was economically sound, there was little public debate in the siting process itself. The utility would apply to the state utility regulatory commission for a certificate of public convenience and necessity, and if this application was approved, it would acquire the site using its right of eminent domain, and then build the facility after securing the necessary permits.[3] However, a number of changes have occurred during the past decade to transform this orderly siting process into one of the most controversial aspects of domestic energy development.

First, as environmental concerns have increased during the past decade, numerous environmental laws and regulations which affect siting of energy facilities have been enacted at both the federal and state levels. Individual citizens, organized interest groups, and governmental agencies are using these legal avenues to participate in siting decisions. Taken together these factors have increased the justifications required of companies seeking siting permits for new facilities. Second, interest groups have successfully challenged siting plans and delayed final siting decisions for some facilities through the use of public hearings and litigation. Third, increased reliance on domestic energy resources has forced many utilities from other regions to site energy facilities in the West. This pattern of development has generated reaction in the West about regional exploitation and neocolonialism.[1] Finally, specific legislation is now in effect in several states concerning energy facility siting. These state laws have provided a new platform for debate over the necessity of new energy facilities, have increased interregional conflict, and have created concern over the role of state planning in a time of "national emergency."

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[1] See Western Interstate Nuclear Board. Regional Factors in Planning and Siting Electrical Energy Facilities in the Western States. Washington, D.C.: U.S., Nuclear Regulatory Commission, 1977, pp. 52-53.

[2] See U.S., Nuclear Regulatory Commission, Office of Special Studies. Nuclear Energy Center Site Survey--1975, 5 parts, Executive Summary and Appendix. Springfield, Va.: National Technical Information Service, 1976.

[3] Cirillo, Richard R., et al. An Evaluation of Regional Trends in Power Plant Siting and Energy Transportation. Argonne, Ill.: Argonne National Laboratory, 1976, p. 15.

These factors have altered considerably the siting process in the West and elsewhere and have contributed to delays in many energy projects. Although public participation is greater because of new laws and institutions, the policy system still does not have the capability to identify and utilize "best-fit" sites for new energy facilities systematically. In the following sections, the emergence of environmental legislation, increased public participation, and interregional conflict as factors influencing the siting process are discussed in more detail.

A. Environmental Legislation

As described in Chapter 1, environmental legislation affects energy development in general and energy facility siting in particular. The earliest federal environmental legislation affecting energy facility siting stems from the Rivers and Harbors Act of 1899 which provides the Army Corps of Engineers permitting power for the use of navigable waters.[2] The federal role was expanded by the Federal Water Pollution Control Act (FWPCA) Amendments of 1972 which gave the EPA permitting authority over energy facilities that discharge effluents.[1] This act also controls indirect water quality impacts from the siting of new energy facilities that result in new requirements for local sewage treatment.

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[1] See Lamm, Richard D. "States Rights Vs. National Energy Needs." Natural Resources Lawyer, Vol. 9 (No. 1, 1976), pp. 41-48; and Plummer, James L. "The Federal Role in Rocky Mountain Energy Development." Natural Resources Journal, Vol. 17 (April 1977), pp. 247-55.

[2] Rivers and Harbors Act of 1899, 30 Stat. 1121, 33 U.S.C. § 407 (1970). Navigable waters of the U.S. are those waters which are presently, or have been in the past, or may be in the future susceptible for use for the purposes of interstate or foreign commerce. See Beatty, Haradon. "Federal Water Pollution Control in Transition," in Rocky Mountain Mineral Law Foundation, ed. Rocky Mountain Mineral Law Institute: Proceedings of the 18th Annual Institute. New York, N.Y.: Matthew Bender, 1973, p. 497.

The most far-reaching environmental law affecting siting is the National Environmental Policy Act (NEPA) which mandates the preparation and review of an environmental impact statement (EIS) for all proposed projects which require federal action and which will significantly affect the human environment.[2] The EIS must include a discussion and evaluation of: the environmental setting or existing conditions, proposed facilities, environmental impacts of development, socioeconomic effects, policy alternatives, and unavoidable adverse effects.[3] The EIS process also includes requirements for a review by a wide range of federal, state, regional, and local agencies, and citizens groups.[4] The EIS is a major avenue for public participation in siting decisions due to these extensive review guarantees.

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[1] Federal Water Pollution Control Act Amendments of 1972, Pub. L. 92-500, 86 Stat. 816, 33 U.S.C. § 1251(a) (1970). The Clean Water Act of 1977, Pub. L. 95-217, 91 Stat. 1566, updated some requirements, but did not change the general regulatory environment for energy facilities. See Kirschten, J. Dicken. "The Clean Water Debate--Congress' Stagnant Pool." National Journal, Vol. 9 (September 3, 1977), p. 1378; and Ward, P.S. "Water Act Amendments: Deja Vu in the Halls of Congress." Water Pollution Control Federation Journal, Vol. 49 (October 1977), p. 2059.

[2] National Environmental Policy Act of 1969, Pub. L. 91-190, 83 Stat. 852, 42 U.S.C. §§ 4321-47 (1970). Some authors have disputed the view that NEPA was a major turning point toward a greater consideration of environmental factors in the siting of new facilities. For a study which notes that NEPA has directed attention away from a broader consideration of the alternatives and impacts of development and toward a focus on procedural requirements and the filing of reports, see Fairfax, Sally K. "A Disaster in the Environmental Movement." Science, Vol. 199 (February 17, 1976), pp. 743-48.

[3] See Canter, L.W. Environmental Impact Assessment. New York, N.Y.: McGraw-Hill, 1977.

[4] See Baram, Michael S. Environmental Law and the Siting of Facilities: Issues in Land Use and Coastal Zone Management. Cambridge, Mass.: Ballinger, 1976, pp. 3-39.

Another major step toward controlling facility siting at the federal level came in 1970 when the Clean Air Act (CAA) was passed.[1] This legislation, among other things, extended federal regulatory authority to include stationary air pollution sources, such as energy facilities. Energy facility siting policy is influenced by regulatory criteria, developed under the auspices of this act, which set limits on the emission levels of new facilities and the maximum ambient levels for air quality. Since 1970, the federal air quality controls have been subject to almost continuous modification. The most recent alterations, the 1977 CAA Amendments, established regulations for the PSD of air quality. Under the terms of the 1977 Amendments, air quality areas designated Class I (national parks and other scenic areas) are to be the locations most vigorously protected. Class II areas have more liberal PSD restrictions, and Class III will allow the most degradation in air quality.[2] In addition, areas may be upgraded to Class I by the Administrator of EPA; the Northern Cheyenne Resrevation in Montana is the first such redesignated area in the country.[3] Thus, some areas of the West are effectively precluded as energy development sites in order to maintain currently pristine air quality.

Wildlife preservation legislation constitutes another constraint on siting decisions. Conservationist and environmental interests have been instrumental in supporting legislation to protect both wildlife and wildlife habitat quality. The Endangered Species Conservation Act of 1969 provided federal protection to threatened plants and animals.[4] The Endangered Species Act of 1973 extended this authority to exclude the critical habitat of endangered fish, wildlife, and plants as possible locations for new energy facilities.[5] A list of endangered species was compiled in March 1967 that included 72 native species.[1] As of the end of 1976, some 170 native species were listed as endangered. Although the locations of the critical habitat of several known species have been identified, this information is only a partial basis for excluding potential sites, since many new species will probably be added to the endangered list and an EIS required for a new energy facility can identify new endangered species not previously encountered.[2]

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[1] Clean Air Act of 1970, Pub. L. 91-316, 84 Stat. 416. See Rosenbaum, Walter A. The Politics of Environmental Concern, 2nd ed. New York, N.Y.: Praeger, 1977, pp. 144-57.

[2] Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 685. See Kirschten, J. Dicken. "The Clean Air Conference--Something for Everybody." National Journal, Vol. 9 (August 13, 1977), pp. 1261-63.

[3] See Chapter 6 for further discussion on this subject.

[4] Endangered Species Conservation Act of 1969, Pub. L. 91-135, 83 Stat. 275.

[5] Endangered Species Preservation Act of 1973, Pub. L. 93-205, 87 Stat. 884.

Federal legislation also provides for the protection of historically or culturally significant places. This authority stems from laws enacted as long ago as 1906, but the most recent legislation is the Historic Preservation Act of 1966.[3] Under pressure from the National Trust for Historic Preservation, Congress passed an extension of the 1966 act and increased the funding for preservation efforts in 1970. Basically, these laws mandate the initiation of a federal-state advisory process to eliminate or mitigate any impacts by projects on cultural properties that are, or may be listed in the National Register of Historic Places. These requirements are over and above the NEPA mandate, thus adding another set of procedures to the siting process. Because of the ubiquity of potential "historical places," some energy developers now have staff or employ consultants to examine proposed facility sites for evidence of historical or cultural significance.[4]

B. Increased Public Participation

Another important factor affecting the facility siting process is increased public participation in decisions that were once considered to be primarily in the domain of private industry. The demand for greater citizen involvement in siting energy facilities, reflected in such legislation as NEPA and FWPCA, is based on a perceived need to make the political system more responsive to the general public by incorporating more diverse interests in policy formulation and implementation decisions.[2] In the West, these publics range from environmental and consumer interest groups through economic interests such as farming and ranching to cultural and ethnic participants such as Indians.

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[1] Congressional Quarterly, Inc. *Congress and the Nation, Vol. IV: 1973-1976*. Washington, D.C.: Congressional Quarterly, 1977, p. 290.

[2] U.S., Department of the Interior, Bureau of Sport Fisheries and Wildlife. *Final Environmental Statement for the Proposed Endangered Species Conservation Act of 1973*. Washington, D.C.: Government Printing Office, 1973. For a discussion of the controversy currently surrounding the impact of the endangered species legislation on facility siting, see Carter, Luther J. "The Attorney General and the Snail Darter." *Science*, Vol. 200 (May 12, 1978), p. 628.

[3] Historic Preservation Act of 1966, Pub. L. 89-655, 80 Stat. 915.

[4] See Holden, Constance. "Contract Archeology: New Source of Support Brings New Problems." *Science*, Vol. 196 (June 3, 1977), pp. 1070-72.

Environmental and consumer interests often have been the most vocal opponents of siting energy facilities. Groups such as the Sierra Club, Audubon Society, Friends of the Earth, and Environmental Defense Fund are nationally recognized in part because of the number of times they have intervened in cases to halt or modify siting proposals. Such opposition is usually seen by industry spokesmen as constituting a major roadblock to increased domestic energy supply. According to Richard F. Walker, President of the Public Service Company of Colorado, delays occasioned by environmental interest groups have been a major cause of energy price increases in recent years. But characterizing all environmental and public interest groups as opponents of energy projects is simply inaccurate. Significant differences exist between the energy policy positions of the various national interests representing consumers and environmentalists. Thus, while the more aggressively antinuclear environmental groups such as Ralph Nader's organizations have opposed the construction of new nuclear power plants as part of a "low energy growth" position, other groups, such as Common Cause, have supported development through "mixed market" strategies.[3]

The most intense environmentally-oriented public opposition in the West is voiced over the site-specific concerns of spoiling a unique environment. Opposition to the proposed Kaiparowits power plant in southern Utah centered on the impacts of the facilities at the site. Many of the interests resisting this project did so because they valued the region's "national heritage" properties rather than opposing the facilities because of any

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[1] See Chapter 1 on the emergence of public participation and how it has influenced energy policymaking in general.

[2] Nelkin, Dorothy. Technological Decisions and Democracy: European Experiments in Public Participation. Beverly Hills, Calif.: Sage Publications, 1977, p. 13.

[3] McFarland, Andrew S. Public Interest Lobbies: Decision Making on Energy. Washington, D.C.: American Enterprise Institute for Public Policy Research, 1976, pp. 47-51.

environmental or physical risks associated with development.[1] In contrast, proposals to site similar fossil-fuel facilities in western North Dakota did not generate such widespread environmentally-oriented opposition, probably because the region is not perceived to be as physically and culturally attractive.[2]

Economic interests intervene on both sides of siting questions, and local reactions are difficult to generalize. Whereas those who favor development plans in the West tend to see economic benefits as outweighing environmental and socioeconomic costs, groups in opposition usually perceive local development as producing more costs than benefits for them (see box "Rancher Fearful of Development").[3] Ranchers in Colorado, for example, have voiced concern that the siting of Public Service of Colorado's Pawnee power plant would create emissions that would harm pastures by decreasing their productivity.[4] In another case, the North Dakota Farmers Union joined forces with the Friends of the Earth to demand strict reclamation procedures so that agricultural production would not be sacrificed to coal mining.[5]

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[1] "The Law's Delay: Huge Plant's Demise Signals Trouble Ahead for Energy Expansion." Wall Street Journal, September 7, 1976, p. 1.

[2] For instance, surveys of the perception of residential desirability show that North Dakota is one of the least desirable states in the nation. See Ables, Ronald, John S. Adams, and Peter Gould. Spatial Organization: The Geographer's View of the World. Englewood Cliffs, N.J.: Prentice-Hall, 1971, pp. 519-21.

[3] See Fradkin, P.L. "Craig, Colorado: Population Unknown, Elevation 6,185." Audubon, Vol. 79 (July 1977), p. 120.

[4] "Morgan Commissioner to Decide Fate of Pawnee Power Plant." Denver Post, September 23, 1976.

[5] This is consistent with national and international surveys which have shown that support for the siting of energy facilities is based on expected economic benefits while negative attitudes toward siting result from perceptions of a high likelihood of undesirable, environmental, socioeconomic, or psychological outcomes. See Sundstrom, Eric, et al. "Community Attitudes Toward a Proposed Nuclear Power Generating Facility as a Function of Expected Outcomes." Journal of Community Psychology, Vol. 5 (1977), pp. 199-208.

Interests supporting facility siting because of perceived economic benefits may be local landowners, realtors, bankers, chambers of commerce, or wholesale/retail merchants.[1] In southern Utah, the prospect of some 35,000 new jobs, an additional annual payroll of 100 million dollars, and yearly tax revenues of 28 million dollars overrode whatever environmental concern existed for most residents as local citizens largely supported the Kaiparowits proposal.[2]

RANCHER FEARFUL OF DEVELOPMENT

A rancher outside Colstrip, Montana articulately expressed his fear of new energy facilities. "To me, I just don't think you can put a numerical value on what we have right here. I think it's our responsibility to do with it what we can and turn it over to our children in good shape....Then you get conversion plants, and you think, okay, what's this going to do with the water? How much water is going to come out of the Yellowstone? What's a 200 or 1,000 percent increase of the population of my hometown going to do?...to the tax base?...to the sociological undercurrent?...to my community?..."

--Johnson, Haynes. "The Last Round-up." Washington Post, August 3, 1975, p. C-5. Quotes from Willie MacRae.

Indian tribes have also increased their participation in facility siting decisions. The Indian tribes control between 10 and 16 percent of the nation's coal (one-fifth of strippable western reserves), one-half of the country's uranium (one-sixth of recoverable uranium), and about three percent of the nation's remaining oil and gas.[3] Although Indians do not have a united position on facility siting, the newly created Council of Energy Resource Tribes (CERT) is attempting to establish a common set of rules on prices, production controls, and environmental protection.[4] The Bureau of Mines has assisted in this effort by helping Indian tribes evaluate the financial implications of different negotiating positions.

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[1] A public opinion poll conducted by W.R. Grace and Company in 1974 on western boomtown attitudes found that "those who favored growth expected to make money from it." See Fradkin, P.L. "Craig, Colorado: Population Unknown, Elevation 6,185." Audubon, Vol. 79 (July 1977), p. 121.

[2] Myhra, David. "Fossil Projects Need Siting Help Too." Public Utilities Fortnightly, Vol. 99 (September 29, 1977), p. 26.

[3] Crittenden, Ann. "Coal: The Last Chance for the Crow." New York Times, January 8, 1978, section 3, p. 1.

[4] Greider, William. "Indians Organize Own Energy Combine." Washington Post, July 17, 1977, p. A-3.

Indian efforts to gain greater control over their energy resources have the potential to generate conflict in the siting process. Some tribes, most notably the Apaches, maintain that federal and state siting regulations are not applicable on Indian lands. This contention, if upheld, opens the possibility that in the future sovereign tribes could operate energy facilities under their own environmental standards. The successful court battles Indians have waged over land claims and fishing rights have already created a significant white backlash among ranchers and sportsmen in the West[1]. Nevertheless, Indian tribes appear committed to taking tougher bargaining positions with energy developers, as demonstrated by the recent refusal of the Navajo to allow Western Gasification Company (WESCO) to build a coal gasification plant on the reservation or to grant a right-of-way from a site just off the reservation.[2]

C. Interregional Conflict

Conflicts are also likely to arise because many energy facilities sited in the West will serve demands outside the region. As shown in Chapter 1, the provisions of the National Energy Plan[3] and other Carter Administration proposals place a high priority on developing western energy resources to help decrease dependence on foreign imports and to make it possible to maintain national economic growth. Developing western resources may cause the West to bear a disproportionate share of the impacts of achieving these goals, although the region will also enjoy economic benefits with increased energy development. Thus, siting energy facilities in the West will result in trade-offs between economic and environmental costs and benefits as well as trade-offs between regional autonomy and regional interdependence.

It is particularly disturbing to many westerners that certain regions will receive fuel but will not be subject to the impacts of the energy facilities needed to produce that fuel. For instance, officials in Montana have announced that they do not intend to be subjected to outside "exploitation" and have passed tough energy facility siting laws to prevent this from occurring.[4] For example, Montana now mandates an application fee for new facilities--a fee which can be as much as two million dollars for a one billion dollar plant.[1]

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[1] "U.S. Indians Demand a Better Energy Deal." Business Week, December 19, 1977, p. 53.

[2] "Navajos Reject $1-Billion Coal Gasification Plant." Coal Mining and Processing, Vol. 15 (May 15, 1978), pp. 20-21.

[3] U.S., Executive Office of the President, Energy Policy and Planning. The National Energy Plan. Washington, D.C.: Government Printing Office, 1977.

[4] "Stiff Environmental Regs Slow U.S. Energy Plans." Oil and Gas Journal, Vol. 76 (February 6, 1978), p. 19.

On the other hand, some westerners see energy resource development as a boon and are fighting to retain the advantages of using western energy on a long-term basis. Wyoming's Senator Clifford P. Hanse, for example, is outraged by the Carter Administration's plan to emphasize the use of local coal to serve local markets (see box "Administration Favors Use of Local Coal").[2] Responding to a concern that those coal-rich areas in the East which have high unemployment levels might be bypassed in favor of western resources, this plan reflected the views of Easterners like Ohio's Senator Howard M. Metzenbaum who argued: "Do we mean that we will require coal to be transported across the entire country when there is plenty of coal available in the very regions...the utilities operate in?"[3]

On a larger scale, a war of words exists between such regional organizations as the Western Governors' Policy Office (WESPO) and the Coalition of Northeastern Governors (CONEG). The western governors have argued that the West should not be forced to bear the environmental and socioeconomic costs of large scale energy development to subsidize the energy needs of industrial states. CONEG governors argue that they are already laden with negative impacts from existing industries that serve the entire nation and that their federal taxes have subsidized the development of the West.[4]

D. Intergovernmental Jurisdiction

The federal government has little direct authority over the siting of nonnuclear energy facilities; most siting responsibility resides in state and local governments. The disposition of public lands is one area where the federal government does have direct authority over energy facility location. However, the indirect federal control of siting is a predominant phenomenon. Through such mechanisms as the EIS requirements of NEPA and legislation such as the CAA and FWPCA, the federal government is able to intervene in the siting process. Since the passage of the Federal Power Act in the 1930's,[1] the federal government has also assumed responsibility for overseeing the use and operation of interstate gas and electrical supply systems.

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[1] Montana Major Facility Siting Act of 1975. Montana Revised Codes Annotated §§ 70-801 through 70-823 (Cumulative Supplement 1975).

[2] This point is also discussed in Chapter 10, Capital Availability.

[3] Kirschten, J. Dicken. "Watch Out! The Great Coal Rush Has Started." National Journal, Vol. 9 (October 29, 1977), p. 1683.

[4] Peirce, Neal R. "Northeast Governors Map Battle Plan for Fight over Federal Funds Flow." National Journal, Vol. 8 (November 27, 1976), p. 1699.

The consideration of more comprehensive federal siting legislation has been complicated by a continuing debate over two very different approaches to siting policy. On the one hand, there is pressure for a generic approach, national in scope, which would emphasize comprehensive land-use planning as a prerequisite for narrower choices regarding the need for energy, the type of fuel and source, the general location and type of facility, the actual site selection, the design and construction, and the operating guidelines. The proposed Land Resources Planning Act of 1975, for example, included facility siting as only one component of overall land-use planning. Title III of this act, the Energy Facilities Planning Act, would have required public participation and consideration of regional and national energy needs.[2] On the other hand, pressures also work toward a more flexible, site-specific approach which would then aggregate the particulars of siting into a national land-use plan. Thus, the Energy Facilities Planning and Development Act, also proposed in 1975, relegated land-use planning to a function of the site selection process. This legislation, however, would have required each state to design an energy facility program and would have given the federal government extensive data collection and forecasting responsibilities. Many state officials were concerned that these provisions could preempt state authority. Thus Governor Richard D. Lamm of Colorado testified against the proposal in Congress

ADMINISTRATION FAVORS USE OF LOCAL COAL

EPA administrator Douglas M. Costle justified the position of requiring stack gas scrubbers on new coal-burning facilities whether they needed them or not. This policy, he said, was intended to "encourage power plants to use locally mined high and medium-sulfur coal instead of bringing in low-sulfur coal from other regions. This will avoid much of the regional unemployment and economic disruption that would result from greater reliance on low-sulfur coal than on control technology."

--Kirschten, J. Dicken. "Watch Out!" The Great Coal Rush Has Started." National Journal, Vol 9 (October 29, 1977), p. 1683.

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[1] Federal Power Act of 1935, Title II of Public Utility Act of 1935, Pub. L. 74-333, 49 Stat. 838.

[2] U.S., Congress, Senate, Committee on Interior and Insular Affairs. Congress and the Nation's Environment. Washington, D.C.: Government Printing Office, 1977, pp. 1383-1516.

and other governors expressed similar fears that the legislation threatened states' rights.[1] Both 1975 proposals were ultimately defeated as was the Electric Utility Rate Reform and Regulatory Improvement Act of 1976. Title V of this bill would have required energy firms to report to the FPC their prospective sites, their efforts to protect the environment, and their provisions for involving land-use agencies in the planning processes. Under the terms of this bill the FPC would have been responsible for the preparation of national energy facility siting plans. And the FPC would have taken the lead role as the sole legal authority for licensing facilities in a federal "one-stop" siting process featuring a single composite utility application.

Many of these reforms have been proposed because the number of state permits and approvals for siting an energy facility, most of which are over and above the federal requirements, have added significantly to the mandatory decision points in the siting process. For example, Table 12-3 lists the number and types of major permits and approvals that must be obtained before a coal gasification facility in North Dakota can be constructed and operated. And judicial reviews of agency decisionmaking have added another level of intervention to the process.

The facility siting process in most states is extremely decentralized because numerous single-purpose laws influence the final siting decision. The simultaneous imposition of energy, environmental, land use, and consumer protection laws, each of which may apply to distinct elements of new energy facilities, creates an extraordinarily complex process.[2]

State and local authority governing energy facilities is based on the "police power," control over state-owned lands, and the authority to implement federal legislation. The police power of state governments includes zoning laws, building codes, subdivision regulations, permit requirements, and performance standards. Traditionally, state public utility commissions have used the criteria of "public convenience and necessity" to evaluate siting proposals. Issuance of this certificate demonstrates that the state accepts the utility's demand forecasts and evaluations of the impacts of this additional facility on the retail rate structures. But during the past several years some western states have passed explicit siting bills to coordinate, supervise, and

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[1] The Energy Center, Inc. "Issues in Power Plant Siting: The 94th Congress and the States," in U.S., Federal Energy Administration. FEA Energy Facility Siting Workshops. Springfield, Va.: National Technical Information Service, 1977, p. 378.

[2] Mills, Jon L., et al. Energy: The Power of the States. Gainesville, Fla.: University of Florida, Holland Law Center, Center for Governmental Responsibility, 1975, p. 91.

TABLE 12-3: PERMITS, APPROVALS, AND CERTIFICATIONS REQUIRED BEFORE A COAL GASIFICATION FACILITY COULD BEGIN CONSTRUCTION AND OPERATION IN NORTH DAKOTA

AGENCIES	PERMIT AND/OR APPROVAL
Federal	
U.S. Army Corps of Engineers	Easement for Water Intake, Pipeline, and Access Road; Section 10 Permits for Water Intake and Pipeline Crossings of Major Streams; Section 404 Permits for Wetland Disturbance
Environmental Protection Agency	New Source Performance and Air Quality Significant Deterioration Review, Deep Well Disposal Review
Federal Power Commission	Certificate of Public Convenience and Necessity
Federal Aeronautical Administration	Application for and Notice of Proposed Construction for Structures over Regulated Heights
U.S. Bureau of Reclamation	Water Service Contract, Environmental Impact Statement
State	
North Dakota Public Service Commission	Plant Certificate of Site Compatibility, Water Pipeline Certificate of Site Compatibility, Water Pipeline Transmission Facility Route Permit, Mining Plan
North Dakota Department of Health	License for Radioactive Measuring Device Operations, Hazardous Waste Control Plan, Wells for Temporary Water Supply, Sewage Treatment Plant
Environmental Engineering Division	Permit to Construct (Air Pollution Control Permit) Permit to Operate (Air Pollution Control Permit)
Water Supply and Pollution Control Division	NPDES Permit for Deep Well Disposal, Solid Waste Disposal Permit
North Dakota State Highway Department	Rail Siding Crossing, Pipeline Construction on Highway Right-of-way
North Dakota State Water Commission	Appropriation of Underground Water, North Dakota State Water Permit (conditional permit obtained)
North Dakota Secretary of State	Certificate of Authority for Foreign Corporation to Transact Business
North Dakota Unemployment Compensation Division of Employment Security Bureau	Application for Coverage by ANGCGC
North Dakota Workman's Compensation Bureau	Covered by ANGCGC
Mercer County	
Board of Commissioners	Petition for Access to County Roads, Petition for Vacating County Road and Closing Section Lines, Certificate of Zoning Compliance, Plantsite Rezoning, Conditional Use Permit
Soil Conservation District	Erosion and Sediment Control Plan

NPDES = National Pollutant Discharge Elimination System
ANGCGC = American Natural Gas Coal Gasification Company

Source: U.S., Department of the Interior, Bureau of Reclamation, Upper Missouri Region. ANG Coal Gasification Company, North Dakota Project: Draft Environmental Impact Statement. Billings, Mont.: Bureau of Reclamation, 1977, pp. I-9 and I-10.

control siting decisions. Such laws are a major step toward coordinating the state land use, health, building and other single-interest agencies involved in siting decisions, and they simplify the process of evaluating the trade-offs involved in locating a particular facility.[1]

Five of the states in our study area--Arizona, New Mexico, North Dakota, Montana, and Wyoming--have siting laws; three--South Dakota, Utah, and Colorado--do not. Characteristics of these state energy facility siting laws are summarized in Tables 12-4 and 12-5. As indicated by these tables, the siting laws of North Dakota, Montana, and Wyoming cover the widest variety of processing and transmission facilities.

The new state siting agencies are generally charged with the responsibility for viewing siting proposals holistically rather than following the single-purpose criteria of the older state health, safety, and welfare regulatory bodies. In practice, however, much of the policymaking process is still fragmented. In Wyoming, for example, a relatively rigorous siting law is still subject to the decisions of the State Engineer and the Public Service Commission. But despite claims that these fragmented state laws contribute to delays in the licensing of facilities, the amount of time required to site energy facilities in states with and without state regulation does not differ widely.[2]

State control of facility siting is also bolstered by state implementation of federal environmental legislation, especially state oversight of air and water quality laws and regulations through "state environmental policy acts" (SEPA's). Six of the eight western states have some sort of SEPA; Utah and New Mexico do not.[3] Arizona, Montana, and South Dakota SEPA's require an EIS that involves detailed consideration of environmental impacts prior to site development. North Dakota and Wyoming have SEPA's that stress the enforcement of criteria after the facility is on line. Colorado has a coordinating and planning mechanism that is only an advisory adjunct to the state's environmental policymaking.

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[1] See Verity, Victor, John Lacy, and Joseph Geraud. "Mineral Laws of State and Local Government Bodies." In Rocky Mountain Mineral Law Foundation, ed. The American Law of Mining, Vol. 2. New York, N.Y.: Matthew Bender, 1974, pp. 627-38.

[2] Calvert, J.R. "Licensing Coal-Fired Power Plants." Power Engineering, Vol. 82 (January 1978), pp. 34-42.

[3] U.S., Council on Environmental Quality. Environmental Quality, Seventh Annual Report. Washington, D.C.: Government Printing Office, 1976, pp. 133-35.

TABLE 12-4: FACILITIES COVERED BY SITING LAWS ENACTED BY STATES IN THE EIGHT-STATE STUDY AREA

STATE	PROCESSING	TRANSMISSION
Arizona	Thermal, nuclear or hydroelectric plants capacity 100 megawatts and associated infrastructure	HVTL ≥115 kV
Montana	Plants with capacity ≥50 megawatts; processing of gas ≥25,000,000 cubic feet/day; processing of hydrocarbons ≥25,000 bbl/day; "yellowcake" enrichment whose plant costs ≥$250,000; any facility capable of utilizing, refining, or converting 500,000 tons coal/year	HVTL associated with facilities ≥69 kV (except HVTL ≤230 kV if less than 10 miles length) pipelines (gas, water, liquid hydrocarbons) from mentioned facilities, or geothermal plants, *in situ* gasification, subsurface conversion
New Mexico	Oil, gas, uranium, geothermal plants with generation capacity ≥300 megawatts	HVTL ≥230 kV
North Dakota	Plant capacity 50 megawatts; manufacture or refinement of 100,000,000 cubic feet of gas/day; manufacture or refinement of 50,000 bbl liquid hydrocarbons/day; enrichment of uranium materials	HVTL 200 kV HVTL 69 kV if lines do not follow ¼ or whole section lines or paths of other transport modes; gas or liquid pipelines (coal, gas, water, liquid hydrocarbons) to or from facilities mentioned herein
Wyoming	Plant capacity ≥100 megawatts; facility capable of producing 100 million cubic feet synthetic gas/day; 50,000 bbl liquid hydrocarbons/day; "yellowcake" enrichment capacity 2,500 lbs/day; any industrial facility with an estimated cost of $50,000,000	Not specified

HVTL = high voltage transmission lines
≥ = is greater than or equal to
kV = kilovolts
≤ = is less than or equal to
bbl = barrels

TABLE 12-5: PROVISIONS OF STATE POWER PLANT SITING LAWS IN THE EIGHT-STATE STUDY AREA

STATE	POWER SITING LAW	LEAD AGENCY	SITE CERTIFICATION AUTHORITY	SIZE AND COMPOSITION OF SITE PANEL	METHOD OF ACQUISITION	APPLICATION FEE	ANNUAL UTILITY FORECAST
Arizona	Yes	Yes	Arizona Power Plant Siting Committee	11 State Officials, 7 others	Certification of Environment Compatibility	New Site $10,000 Expansion $7,500	10 Year Plan
Colorado	No						
Montana	Yes	Yes	Board of Natural Resources	----	Application to Site Authority	Based on Facility Cost	10 Year Plan
New Mexico	Yes	Yes	Public Utilities Commission	----	Eminent Domain	None	None
North Dakota	Yes	Yes	Public Service Commission	----	Certification of Compatibility	$150,000 Maximum	10 Year Plan
South Dakota	No						
Utah	No						
Wyoming	Yes	Yes	Industrial Siting Council	7 Government Appointees	Permit	$100,000 Maximum	5 Year Plan Updated Annually

Source: Southern Interstate Nuclear Board. Power Plant Siting in the United States. Atlanta, Ga.: Southern Interstate Nuclear Board, 1976, pp. viii-x.

Municipalities can also affect the location of energy facilities through local zoning ordinances, building codes, health and sanitation standards, and local taxation policies. Through such mechanisms as zoning, the community has full authority to determine the siting of energy facilities within its jurisdiction. However, these land-use control tools have not been widely used in the West; because municipalities tend to be small in area, and most new facilities are located beyond local governmental boundaries. As a result, localities often have been forced to "decide limited issues, play a reactive role only, and make policy by default."[1]

Although efforts have been made at both the state and federal levels of government to streamline the siting process and to reduce the overlaps and inconsistencies in facility siting permitting procedures, the process is still complicated and overall policy is made more on the basis of state and local interests than on regional or national needs. While state siting commissions and environmental impact statements do consider the broader implications of a proposed facility, they generally focus on the impacts of the new facility on the surrounding area and do not attempt to plan interrelated siting strategies. State siting commissions give little attention to the implications of a facility for interstate power systems, despite the fact that regional planning institutions do exist in the West. For instance, the Western Systems Coordinating Council is a power system serving eleven western states.[2] However, this council is more concerned with system reliability and information exchange than it is with energy facility siting planning for firms in its region. An exception to the lack of regional planning in the West is Montana's Major Facility Siting Act[3] that lists the relationship of energy facilities to the regional grid distribution system as one criterion for siting. Because all major electrical production facilities are tied together in the regional power pool, siting new facilities affects the reliability and efficiency of the entire system. Moreover, generalized impacts to the area could be minimized if appropriate sites were chosen beforehand, rather than evaluating the site ex post facto.

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[1] Aron, Joan B. "Decisionmaking in Energy Supply at the Metropolitan Level: A Study of the New York Area." Public Administration Review, Vol. 35 (July/August 1975), p. 344.

[2] Wengert, Norman, and Robert M. Lawrence. Regional Factors in Siting and Planning Energy Facilities in the Eleven Western States, a report to the Western Interstate Nuclear Board. Lakewood, Colo.: Western Interstate Nuclear Board, 1976.

[3] Montana Major Facility Siting Act of 1975, Montana Revised Codes Annotated §§ 70-801 through 70-823 (Cumulative Supplement 1975).

12.2.3 Summary

The extensive array of laws and regulations that compose the present energy facility siting process and the manner in which actual siting policy is made is not an effective mode of selecting the "best-fit" sites. The initial selection of sites is made by industry based on proprietary site evaluation criteria and methodologies. The general public often becomes aware of siting choices only after a site is selected and the developer is financially committed to the project. Interest groups may participate in the process only after plans are publicly disclosed. Their input is more likely to influence the design of the facility than to provide constructive input regarding the most suitable sites for new facilities.[1]

The existing policy context for energy facility siting leads to delays in locating new facilities and is not well suited for incorporating broad participation in determining the trade-offs among different sites. Conflicts often occur since the criteria for evaluating sites differ from group to group and from stage to stage in the siting process. An attractive site from the developers' point of view may be a poor choice in the eyes of environmental, economic, or cultural interests which become involved at a later stage.[2] The environmental groups may be more concerned with ecological impacts, local ranchers and farmers are interested in the project's impacts on agricultural productivity, and Indians may focus participation efforts on perceived lifestyle changes. For the utility, however, the overriding criteria are economic efficiency and system reliability.

The principal concerns of this chapter are the goals of utilizing the "best-fit" sites for new energy facilities and bringing needed energy facilities on-line expeditiously. To accomplish these goals it is essential to modify policymaking processes by providing more accessibility to the siting decision for all major interests. Also, an overall strategy for developing western energy resources while keeping environmental degradation to a minimum probably requires a regional perspective and the early identification of energy demand needs.

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[1] See Greene, Thomas. "Reforming Procedures for Industrial Siting." American Bar Association Journal, Vol. 61 (April 1975), pp. 449-52.

[2] See Gros, Jaques G., et al. "A Systems Analysis Approach to Nuclear Facility Siting." Behavioral Science, Vol. 21 (March 1976), pp. 116-27.

12.3 ALTERNATIVE POLICIES FOR ENERGY FACILITY SITING

12.3.1 Introduction

In combination, the problems and issues discussed above make facility siting one of the most significant aspects of energy development in the West. Some of the major problems with the current energy facility siting process include: the authority for siting policy is fragmented among several levels of government and among several agencies at each level, and delays are commonplace as a result of gaps and overlaps which characterize this policymaking system; site selection policy is usually made by private industry and does not always include adequate consideration of values important to other groups; many parties-at-interest enter the siting process too late to be involved in early planning and often resort to delaying tactics after plans are finalized; and too little effort is made to match energy technologies to locations on multiple criteria, with the result that impacts and opposition are often greater than necessary.

These problems suggest two policy objectives for facility siting: to site energy facilities in locations that will not result in unacceptable costs and risks; and to provide the means for public participation in siting decisions without causing unreasonable delays.

The first objective can be attained in a variety of ways. As outlined in Table 12-6, there are two categories of policy alternatives for selecting acceptable sites:

- Undertake technology-site evaluations;
- Employ impact assistance methods.

By ensuring that the siting process is used to avoid or reduce impacts from energy facilities, opposition and delays could be reduced or better accommodated. Many specific alternatives that would address this objective require action at either the state or federal level to determine the acceptability of both technologies and locations. But replacing the current case-by-case, reactive system for siting decisions with more comprehensive statewide or regional planning will require a more positive view of energy planning than currently exists in the West.

Table 12-6 also illustrates that there are two categories of alternatives for providing the means for increased public participation in the energy facility siting process:

- Increase citizen involvement in siting decisionmaking;
- Provide participation process support.

TABLE 12-6: OBJECTIVES, CATEGORIES OF ALTERNATIVES, AND SPECIFIC ALTERNATIVES FOR ENERGY FACILITY SITING

OBJECTIVE	CATEGORY OF ALTERNATIVES	SPECIFIC ALTERNATIVES
Site energy facilities in locations that will not result in unacceptable costs and risks	Undertake technology-site evaluations	Designate acceptable and unacceptable technology-location combinations Implement site screening and site banking techniques
	Employ impact assistance methods	Require impact mitigation by developers, state or federal governments Compensate state and local governments for impacts
Provide the means for interested parties to participate in siting decisions without causing unreasonable delays	Increase citizen involvement in siting decisionmaking	Provide for information exchange between participants and agencies Encourage administrative interaction between agencies and participants Allow direct participant input into agency decisions
	Provide participation process support	Provide technical or financial assistance for participants

Although it has been a common assumption that greater public involvement in the siting process has directly caused a major portion of the delays in licensing facilities, recent studies have shown that citizen intervention may be a relatively minor factor contributing to the lengthening of the time it takes to get a plant on-line.[1] Even if some short-term costs are paid for public participation, providing access and information to the full range of interested parties may increase the certainty that siting decisions are eventually made.

The remainder of this section discusses in more detail the alternatives for responding to facility siting problems and issues. Specific alternatives, implementation strategies, and constraints are described in the next subsection (12.3.2). Section 12.3.3 evaluates the specific alternatives. This evaluation is based on the standard criteria discussed in Chapter 3 and used throughout this report.

12.3.2 Description of Alternatives

Each of the four categories of alternatives shown in Table 12-6, and briefly outlined above includes various specific alternatives for dealing with siting problems. Each of these specific alternatives has different strategies for implementing the particular response, and each is characterized by distinct constraints on implementation.

A. Undertake Technology-Site Evaluation

This category includes two specific alternatives, as shown in Table 12-7:

- Designate acceptable and unacceptable technology-location combinations;
- Implement site screening and site banking techniques.

Both alternatives are based on the exclusion of some areas from energy development, and both represent an extension of current zoning practices on a larger scale. Encouraging certain technology-location combinations would employ procedures similar to the use of eminent domain or the condemnation of areas for a particular land use. Discouraging, or prohibiting the use of certain areas

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[1] A recent General Accounting Office study of the nuclear energy facility siting process found that citizen intervention in the issuance of construction permits, long thought to be a major source of siting delays, actually added only five months to the ten years necessary to bring a plant on-line. See Kirschten, J. Dicken. "Nuclear Licensing Reform--A Bomb About to Explode." National Journal, Vol. 10 (January 7, 1978), pp. 13-15.

TABLE 12-7: SPECIFIC ALTERNATIVES, IMPLEMENTATION STRATEGIES, AND CONSTRAINTS FOR ENCOURAGING AND DISCOURAGING CERTAIN TECHNOLOGY-LOCATION COMBINATIONS

SPECIFIC ALTERNATIVES	IMPLEMENTATION STRATEGIES	CONSTRAINTS
Designate acceptable and unacceptable technology-location combinations	State or federal legislation prohibiting certain types of facilities and/or certain areas	Difficulty of definition, rapidly changing technologies and locations
	Taxation of unacceptable facilities or subsidies for acceptable facilities in acceptable areas	Expensive and difficult to define standards of unacceptability
	Developers, interest groups, and government jointly defining acceptability/ unacceptability	High potential for interest group conflict, time-consuming, and vulnerable to lobbying
Implement site screening and site banking techniques	State or federal regional studies, determination of acceptable zones, and specific site analyses	Dependent on reliable and credible data regarding energy needs, population trends, etc.
	State or federal selection and purchase of sites for certain facilities or categories of facilities	Requires a high level of funding and emphasis on long-range planning

as unacceptable sites for energy facilities rests on more limited and more recent experience with the use of such schemes as air quality classifications. These mechanisms for the identification of unacceptable areas for development could be extended to include other criteria such as water availability, socioeconomic impacts, or consumption of agricultural land. As an example of how the unacceptability of locations may be determined, Table 12-8 shows some types of sites to be excluded under North Dakota's Energy Conversion and Transmission Facility Siting Act.[1]

Other, more flexible methods for determining the acceptability of sites would rely on site screening to evaluate each technology-location configuration individually. Thus a power plant using wet cooling might be screened out of a particular area although other energy technologies would be quite acceptable at the site. Table 12-9 outlines some examples of the criteria which might be used in a site screening process. After acceptable technology-location combinations have been agreed upon, there are a number of available techniques for improving and acquiring sites. One such technique is "site banking," which would provide for state authority to preapprove sites (according to screening or some other device for determining acceptability) as much as ten years before they are needed. By marrying a preapproved site with an acceptable technology, developers could bypass many of the lengthy individualized plant reviews now necessitated by today's "custom designed" facilities.[2]

These specific policy alternatives can be implemented by means of a number of strategies, as illustrated in Table 12-7. For the most part, the implementation strategies for evaluating certain technology-location combinations are formal, governmental regulatory and economic policies designed to influence the decisions of private industry. Thus, designating acceptable technologies and locations may be achieved directly through federal or state laws or indirectly by taxation or subsidies. Similarly, site screening and banking may be implemented comprehensively by state or federal legislative mandates or through more flexible selection and purchasing policies, but there is also an implementation strategy which is informal in nature. The determination of acceptable and unacceptable sites could be made by a combination of participants from government agencies, industry, and interest groups employing a strategy similar to the "rule of reason" used by the National Coal Policy Project. The principles guiding this project emphasized a sharing of all relevant data,

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[1] Energy Conversion and Transmission Facility Siting Act, North Dakota Century Code, Chapter 49-11-10.

[2] See Metz, William D. "Nuclear Licensing: Promised Reform Miffs All Sides of Nuclear Debate." Science, Vol. 198 (November 11, 1977), pp. 590-93.

TABLE 12-8: AREAS EXCLUDED AS SITES FOR NEW ENERGY CONVERSION FACILITIES IN NORTH DAKOTA

EXCLUSION AREAS:

(a) Designated or registered: national parks; national historic sites and landmarks; national historic districts; national monuments; national wilderness areas; national wildlife areas; national wild, scenic or recreational rivers; national wildlife refuges; and national grasslands.

(b) Designated or registered: state parks; state forests; state forest management lands; state historic sites; state monuments; state historical markers; state archaeological sites; state grasslands; state wild, scenic or recreational rivers; state game refuges; state game management areas; and state nature preserves.

(c) County parks and recreational areas; municipal parks; parks owned or administered by other governmental subdivisions; hardwood draws; and enrolled woodlands.

(d) Areas critical to the lifestages of threatened or endangered animal or plant species.

(e) Areas where animal or plant species that are unique or rare to this state would be irreversibly damaged.

(f) Prime farm land and unique farm land, as defined by the Land Inventory and Monitoring Division of the Soil Conservation Service, United States Department of Agriculture.

(g) Irrigated land.

AVOIDANCE AREAS:

(a) Areas of historical, scenic, recreational, archaeological, or paleontological significance which are not designated as exclusion areas.

(b) Areas where surface drainage patterns and groundwater flow patterns will be adversely affected.

(c) Within the city limits of a city or the boundaries of a military installation.

(d) Areas within known floodplains as defined by the geographical boundaries of the 100 year flood.

(e) Areas that are geologically unstable.

(f) Woodlands and wetlands.

Source: North Dakota Energy Conversion and Transmission Facility Siting Act, North Dakota Century Code, Chapter 49-22-10.

TABLE 12-9: EXAMPLES OF CRITERIA USED IN SITE SCREENING PROCESS

ISSUE	CONSIDERATION	MEASURE	CRITERIA FOR INCLUSION
Health and safety	Radiation exposure	Distance from populated areas	Areas >3 miles from populated places >2500 Areas >1 mile from populated places <2500
	Flooding	Height above nearest water source	Area must be above primary floodplain
	Surface faulting	Distance from fault	Areas >5 miles from capable or unclassified faults >12 miles in length
Environmental effects	Thermal pollution	Average low flow	Rivers or reservoirs yielding 7 day average, 10 year frequency low flow >50 ft^3/s
	Sensitive or protected environments	Location with respect to ecological areas	Areas outside designated protected ecological areas
Socioeconomic effects	Tourism and recreation	Location with respect to designated scenic and recreational areas	Areas outside designated scenic and recreational areas
System cost and reliability	Routine and emergency water supply and source characteristics	Cost of cooling water acquisition	Rivers or reservoirs yielding 7 day average, 10 year frequency low flow > 50 cfs
		Cost of pumping water	Areas <10 miles from water supply Areas <800 feet above water supply
	Delivery of major plant components	Cost of providing access for major plant components	Areas within 25 miles of navigable waterways

> = greater than
< = less than
cfs = cubic feet per second

Source: Keeney, Ralph L., and Keshavan Nair. "Nuclear Siting Using Decision Analysis." Energy Policy, Vol. 5 (September 1977), p. 224.

simplification of complex concepts, isolation of subjective factors and value judgments, and a commitment on the part of all participants to avoid dogmatic negotiating tactics.[1] Such an approach applied to the siting process could facilitate the comprehensive selection of technology-location combinations and could reduce permitting and approval delays by minimizing the opposition to those sites deemed acceptable.

An examination of the "constraints" column of Table 12-7 reveals that the most significant obstacles to the implementation strategies outlined above have to do with defining the standards of acceptability and unacceptability. Although state or federal legislation could easily mandate certain technology-location combinations, all of the strategies considered in this section would work most effectively with active industry and interest group participation in the process of working out these definitions. As mentioned above, reaching any advance consensus on sites for future energy development requires not only a high level of funding but also a high degree of commitment to energy planning.

B. Employ Impact Assistance Methods

This category of alternatives, outlined in Table 12-10, includes the following specific alternatives:

- Require impact mitigation by developers, state, or federal governments;
- Compensate state and local governments for impacts.

These policy options respond to the variety of impacts that result from siting energy technologies. Given the fact that "technological fixes" may have little effect on some impacts of development, particularly socioeconomic factors, policymakers may be faced with the choice of either attempting to moderate these impacts (mitigation) or making an effort to "buy off" those impacted groups (compensation).

Impact mitigation by energy developers currently is voluntary in most states. The social and economic impacts that result from rapid population growth are those that energy developers have made some efforts to ameliorate, as described in Chapters 8 and 9. These voluntary actions, however, tend to leave a number of impacts outstanding, and many of these unmitigated effects of

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[1] Carter, Luther J. "Coal: Invoking 'the Rule of Reason' in an Energy-Environment Conflict." Science, Vol. 198 (October 21, 1977), pp. 276-79. See also Murray, Francis X., ed. Where We Agree: Report of the National Coal Policy Project, 2 vols. Boulder, Colo.: Westview Press, 1978.

TABLE 12-10: SPECIFIC ALTERNATIVES, IMPLEMENTATION STRATEGIES, AND CONSTRAINTS FOR REDUCING UNDESIRABILITY OF ENERGY FACILITIES AT CHOSEN SITES

SPECIFIC ALTERNATIVES	IMPLEMENTATION STRATEGIES	CONSTRAINTS
Require impact mitigation	Establishing mitigation procedures as mandatory components of state or federal siting legislation	Complicates siting laws and would be difficult to enforce
	Taxes on energy development to fund mitigation or tax incentives to encourage mitigation by developers	Could subsidize worst impacting developments and discriminate against low impact technologies and locations
Compensate state and local governments for impacts	Developer payments to citizens adversely affected by projects	Increases difficulty of determining impacted citizens
	Taxes on energy production for public redistribution	Extremely difficult to implement beyond the local level

energy development are not susceptible to solutions based on only a quick infusion of federal or state funding.

Siting laws in several states do require certain conditions to be met prior to the issuance of a permit. These prior conditions can include the mitigation of socioeconomic impacts, such as providing services or funding to communities, or the construction of needed facilities. The best example of this type of response in the West is the requirement that the Wyoming Industrial Siting Administration issue a permit only after studies of local community needs.[1] Under this authority, developers have agreed to provide housing units and other services as part of the energy facility siting process (see Chapters 8 and 9).

Even without specific siting legislation, industry could be induced to take a greater role in impact mitigation. A taxation strategy which provided for deductions for mitigation measures could encourage developers to accept more responsibility for local impacts. Should such incentives prove ineffective, taxes could be levied on energy development to fund mitigation efforts. For example, tax penalties could be imposed for increases in local government costs due to energy-related population growth.

State or federal government impact mitigation requires an adequate level of funding, and mechanisms for distributing these funds to municipalities which must supply the majority of public services. For example, programs could be designed to allow the state to advance funds so that assistance can be given to communities at the "front end" of the predicted impacts.[1] Severance taxes, royalty payments, and license fees can be structured to cover these costs. States in the West with severance taxes currently allocate a relatively small portion of revenues to impacted areas; this portion would have to be increased substantially to constitute effective mitigation of most local impacts. In states without severance taxes, some other source of state revenue would have to be developed. For example, state revisions of property taxes could provide funds for the local government units where they are most needed; property taxes on valuation of energy facilities could be collected at the state level (including prepayment of taxes by industry to provide funds when they are needed) and redistributed to impacted communities. This specific alternative is discussed at greater length in Chapter 9.

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[1] Monaghan, James E. "Managing the Impacts of Energy Development: A Policy Analysis from a State Government Perspective," in U.S., Congress, House, Committee on Interstate and Foreign Commerce, Subcommittee on Energy and Power; and Senate, Committee on Energy and Natural Resources and the National Ocean Policy Study of the Committee on Commerce. Project Interdependence: U.S. and World Energy Outlook Through 1990, Committee Print. Washington, D.C.: Government Printing Office, 1977, pp. 608-29.

Compensation does not attempt to eliminate the causes of impacts or even to reduce some kinds of impacts. Rather, it offers payments to those who will be adversely affected by energy development. Compensation can counter local opposition to energy development by determining how much people are willing to pay for impacts. This alternative can address a single impact, through measures such as a pollution tax that compensates for damages to air or water quality, or multiple impacts, through bidding procedures. In bidding, a community would establish the acceptable level of compensation it required of a developer to site an energy facility. The bid could include a range of mitigation costs based on estimates of local impacts. If several communities bid, the developer could then include compensation costs in selecting the best site. After compensation has been agreed upon, development could take place with no opposition from the compensated groups.[1]

The major constraints on mitigation and compensation implementation strategies outlined in Table 12-10 are the difficulties involved in determining the impacted citizens and the problems of administering these complex procedures beyond the local level. Identifying those groups adversely affected by energy development is a difficult task at best, but for nationally- or regionally-perceived impacts such as widespread air or water pollution, the process of determining impacted citizens may be impossible. Even if such a determination can be made, redistributing federal or state funds to localities or channeling developer payments to affected groups is a complex procedure which may only serve to subsidize the worst impacting technology-location combinations.

C. Increase Citizen Involvement in Siting Decisionmaking

Table 12-11 outlines the three specific alternatives for increasing public participation in the energy facility siting process:

- Provide for information exchange between participants and agencies;
- Encourage administrative interaction between participants and agencies;
- Allow direct participant input into agency decisions.

These specific alternatives were chosen because they incorporate three principles underlying effective public participation in energy development: public involvement in siting decisions is facilitated by a two-way flow of relevant data; the resolution of administrative and regulatory conflicts in the siting process can

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[1] O'Hare, Michael. "'Not on My Block You Don't': Facility Siting and Strategic Importance of Compensation." Public Policy, Vol. 25 (Fall 1977), pp. 407-58.

TABLE 12-11: SPECIFIC ALTERNATIVES, IMPLEMENTATION STRATEGIES, AND CONSTRAINTS FOR INCREASING CITIZEN INVOLVEMENT IN SITING DECISIONMAKING

SPECIFIC ALTERNATIVES	IMPLEMENTATION STRATEGIES	CONSTRAINTS
Provide for information exchange between participants and agencies	Conducting participation audits Improving notification procedures, settings, and data for public hearings	Difficulties in determining impacted citizens High costs of data and dangers of legalistic and technical information overload
Encourage administrative interaction between participants and agencies	Forming advisory committees for each site prior to applications for permits	Problems of creating public interest and motivating participants early in the siting process
Allow direct participant input into agency decisions	Designating review boards for each siting agency Guaranteeing participant standing in the courts after other participatory options have been pursued	Bureaucratic resistance to participant decisionmaking authority Judicial trends toward limiting the standing of participants

be achieved through the use of both citizen-initiated and citizen-reaction techniques; and full public participation involves citizens actually sharing decisionmaking power.[1]

At present, the exchange of credible and reliable information about proposed energy facilities between industry, government agencies, and potentially impacted parties is generally lacking. If confusion and conflict are to be avoided, industry must be able to communicate to the public basic program facts and information regarding siting alternatives and impacts. At the same time, efforts should be made to discover public values and needs related to the specific site-technology configuration.[2] Thus, the implementation strategies described in Table 12-11 include both information dissemination and information collection techniques.

A participation audit is designed to determine whether a developer has made a reasonable attempt to involve impacted citizens and relevant agencies in the siting process. Prior to issuing a siting permit, the permitting agency would require the submission of a "participatoin statement" by the developer. This document would: (1) characterize the nature and level of potential impacts; (2) identify those citizens to be affected by these impacts; and (3) detail the degree to which all concerned parties had been given an opportunity to become involved in the prepermitting plans and decisions. A permit would not be granted until the developer could demonstrate that consideration had been given to the interests of those who would be impacted by the project. By requiring such an audit of public involvement in the earliest stages of the energy facility siting process, a dialogue could be created between participants and agencies. But, conducting participation audits is constrained by the problems involved in determining the criteria of impacts and by resolving the difficulties of identifying impacted or duly concerned citizens. Identifying those affected parties-at-interest is particularly difficult in the prepermitting phase of facility siting, where there have been few formal actions and citizen interest is low.

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[1] Bishop, A. Bruce, Mac McKee, and Roger D. Hansen. Public Consultation in Public Policy Information: A State-of-the-Art Report, for Energy Research and Development Administration. N. p.: Intermountain Consultants and Planners, Inc., 1978, pp. 8-10.

[2] See Frauenglass, Harvey. "Environmental Policy: Public Participation and the Open Information System." Natural Resources Journal, Vol. 11 (July 1971), pp. 489-96.

Public hearings are the most common information exchange mechanisms in use today in facility siting decisions. Largely as a result of environmental protection legislation such as NEPA, hearings are now required for the licensing of almost every energy facility. Not only must EIS hearing requirements be met, but a host of other construction and operation regulations now require public hearings as standard practice. For example, Table 12-12 outlines the legislative and administrative regulations concerning public participation in energy decisions in the two western states, Colorado and Montana, with the most comprehensive hearings procedures.

Unfortunately, the proliferation of ritualistic public hearings has become one of the major obstacles to the development of a workable energy facility siting policy. Neither the government nor the public is well served by a procedure for which there is often no citizen demand or which results in a one-way, agency-dominated communication process.[1] There are several reasons for the failure of hearings to encourage public participation: inadequate notification, overly formal and highly structured settings, overemphasis on highly technical data. Improving the hearings process may therefore require reforming notification methods to better identify constituencies and to use more innovative media techniques; modifying the setting in which hearings take place to include smaller, more informal groups; and describing the siting alternatives and consequences in language meaningful for the layman.

Reducing siting conflicts by encouraging administrative interaction between participants and agencies could be achieved through an implementation strategy which requires each site to be considered by an advisory committee with broad community representation prior to the permit application stage. Committees composed of industry and environmental groups, local government officials, and residents could provide suggestions on siting problems and issues, act as a "sounding board" for community attitudes toward agency policies, and disseminate siting information to their constituency.[2] But, for advisory committees to contribute

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[1] Heberlein, Thomas A. "Some Observations on Alternative Mechanisms for Public Involvement: The Hearing, Public Opinion Poll, the Workshop, and the Quasi-Experiment." Natural Resources Journal, Vol. 16 (January 1976), pp. 197-212.

[2] See Brown, David S. "The Management of Advisory Committees: An Assignment for the '70s." Public Administration Review, Vol. 32 (July/August 1972), pp. 334-42; see also Bishop, A. Bruce, Mac McKee, and Roger D. Hansen. Public Consultation in Public Policy Information: A State-of-the Art Report, for Energy Research and Development Administration. N.p.: Intermountain Consultants and Planners, Inc., 1978, pp. 59-62.

TABLE 12-12: LEGISLATIVE AND ADMINISTRATIVE REGULATIONS GOVERNING PUBLIC PARTICIPATION IN ENERGY DECISIONS IN COLORADO AND MONTANA

STATE	PUBLIC PARTICIPATION REGULATIONS
Colorado	Sunshine Law: requires opening all meetings of public officials ("any board, committee, commission, or other policy-making or rule-making body of any state agency or authority or of the legislature at which any public business is discussed"). Public notice of meeting is required; minutes must be taken and made available to public. (C.R.S. 24-6-401, 402) Rule-making hearings: opportunity for public to submit views to rule-making body. (C.R.S. 24-4-103) Agency shall notify public of proposed rule change. (C.R.S. 24-4-103) Availability to public of rules and changes in rules; the agency shall supply copies upon request. Licensing hearings are nearly identical with NRC procedures: notification of hearings to public; holding of hearings at convenient time for parties and public; participation of parties (full rights) and limited participation of members of public; people who feel "affected or aggrieved" may petition to be a party to the hearing, and Commission decides legitimacy of his interests; transcripts of hearings are made and available to the public. (C.R.S. 24-4-105) (General procedures, C.R.S. 40-6-109) For utilities policy- and rule-making; notice of all proceedings, applications, petitions, and orders instituting investigations or inquiries shall be given to all persons, firms or corporations who, in the opinion of the Commission, are interested in, or who would be affected by, the granting or denial of any such application, petition, or other proceeding. (C.R.S. 40-6-108)
Montana	Publication and distribution of booklet entitled "A Citizen's Guide to Participation in Government," compiled by the Montana Energy Advisory Council. This booklet describes administrative procedures in laymen's terms and specifically identifies points in process where public participation occurs (elections, petitions, public notices, hearings, protests). It also lists and describes all advisory committees. Public has right to examine public documents. (Constitution of Montana, Article II-9) Public has right to observe deliberations of all public bodies or agencies of the state. (Constitution of Montana, Article II-8)

TABLE 12-12: (Continued)

STATE	PUBLIC PARTICIPATION REGULATIONS
Montana (Continued)	Notice must be given for all proposed rules or rule changes and for agency actions with significant impact on public, such as siting a utility. (R.C.M. 82-4209) An applicant to construct an energy facility must prove that notice of intent has been given to persons residing in the affected municipalities. The notice, involving a summary of the application, must be published on or about the day the application is filed and must appear "in those newspapers as will serve substantially to inform those persons of the application." (R.C.M. 70-806-4) Parties to a hearing for certificaion of environmental compatibility and public need include: "any person residing in a municipality entitled to receive service of a copy of the application under subsection R.C.M. 70-806-4; any nonprofit organization, formed in whole or in part to promote conservation of natural beauty, to protect the environment, personal health or other biological values, to preserve historical sites, to promote consumer interests, to represent commercial and industrial groups, or to promote the orderly development of the areas in which the facility is to be located; or any other interested person." (R.C.M. 70-808-1-c) Each utility, and each person contemplating the construction of a facility in the ensuing 10 years must annually submit a long-range plan for the construction and operation of facilities. "The plan shall be made available to the public by the department . . . Citizen environmental protection and resource planning groups, and other interested persons may obtain a plan by written request and payment to the department." (R.C.M. 70-814)

C.R.S. = Colorado Revised Statutes
NRC = Nuclear Regulatory Commission
R.C.M. = Revised Codes of Montana

Source: Nelkin, Dorothy, and Susan Fallows. The Politics of Participation in Energy Policy. Ithaca, N.Y.: Cornell University, Program on Science, Technology and Society and Department of City and Regional Planning, 1976, Appendix 2.

to public participation in energy facility siting decisions, they must be included in the earliest evaluations of sites and technologies. If citizen participation and advice were secured prior to applications for permits, many developers might avoid alienating concerned groups and could enlist local support to help obtain a more timely "yes" or "no" siting decision.[1]

The third specific alternative listed in Table 12-11, direct participant input into the siting process, enables citizens to share in the actual decisions regarding the choice of technology and location. A variety of implementation strategies may be used to allow public participation to have its most direct impact on the final decision, but the two most viable options involve designating citizen review boards for each siting agency and guaranteeing participant standing in the courts after other participatory alternatives have been pursued. In contrast to advisory committees, citizen review boards can be given full authority to make siting decisions; they include representatives of the broad spectrum of interested parties in an area and have authority to review agency plans or policies. The creation of open and credible citizen review boards for the siting of energy facilities could reduce the level and intensity of conflicts during the early stages of site selection and impact evaluation. And the realization that public participants will have a role in the determination of the final outcome of the siting itself could serve as a "safety valve" reducing conflict and helping to shorten the lead times required before the actual construction of a new facility begins. Moreover, establishing siting review boards within the regulatory agencies could serve to legitimize the agencies' roles and help build public trust in their programs.[2]

Public lawsuits have been one of the primary avenues of citizen participation in energy policymaking for some time. This has especially been the case for environmental interest groups, which have relied on the courts as a "sort of secondary fall-back mechanism" when the legislative-administrative process has failed to provide adequate access to energy decisions.[1] But court challenges by citizens' groups may also contribute to lengthening lead times in the licensing of facilities, in part because adjudication often becomes part of the "politics of desperation" for participants who are opposed to the location of energy projects. However, the use of litigation as a last line of resistance can be reduced by providing meaningful alternative participatory avenues, such as those discussed above. In particular, better performance by the federal and state regulatory agencies as participation mechanisms could contribute to less reliance on the judicial system in siting issues. Lawsuits could still be a viable coercive tool and a supplement to the "volunteerism" of the other participatory techniques if their availability were guaranteed by well defined agency procedures. One such guarantee might involve the assurance of participant standing in the courts after other participatory options had been pursued. This strategy might resolve many siting difficulties before adjudication became necessary. And the ultimate threat of public legal action could be maintained to give impacted individuals and communities bargaining power in the location and operation of energy facilities.[2]

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[1] It should be noted that advisory committees constitute only one of a number of implementation strategies for encouraging administrative interaction between participants and agencies. Other conflict resolution mechanisms would include the task force or ombudsman. See O'Riordan, Timothy. "Policy Making and Environmental Management: Some Thoughts on Processes and Research Issues." Natural Resources Journal, Vol. 16 (January 1976), pp. 55-72.

[2] See Arnstein, Sherry R. "Maximum Feasible Manipulation." Public Administration Review, Vol 32 (July/August 1972), pp. 377-90.

D. Provide Participation Process Support

A single specific alternative for providing participation process support is:

- Provide technical or financial assistance for participants.

Process support for public participation attempts to provide parties-at-interest access to the best technical capabilities for facility siting decisionmaking. To accomplish this, interest groups can be supplied with technical expertise and/or funding. Both options are applicable to the full range of participatory alternatives discussed above.

Many interest groups find it difficult to enter into technological debates with federal or state agencies because technical details are often inaccessible to public participants. And even if technical data are available, they are usually too complex to be useful for the typical citizens' group. Because technological expertise is increasingly a requisite for effective citizen involvement in energy policy, a major participation process support implementation strategy could involve awarding attorneys' fees, expert witness fees, and other reasonable costs of developing technically competent response capabilities within citizens' groups. The Carter Administration has already supported legislation which would provide federal funding to qualified citizens' groups acting as intervenors in nuclear siting hearings.[1] A strategy for implementing technical and financial assistance programs could expand such support to include all federal regulatory processes for all types of energy facilities for the range of information exchange, interaction, and decision input participation techniques.[2]

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[1] Garvey, Gerald. "Environmentalism Versus Energy Development: The Constitutional Background to Environmental Administration." Public Administration Review, Vol. 35 (July/August 1975), pp. 328-33.

[2] Wolpert, Julian. "Regressive Siting of Public Facilities." Natural Resources Journal, Vol. 16 (January 1976), pp. 103-15.

12.3.3 Assessment of Alternatives

This section of the chapter evaluates the four categories of energy facility siting policy alternatives described above. The categories are assessed in a general manner, since each includes a number of specific alternatives and strategies for implementation. First, however, the criteria used to evaluate the categories are identified and discussed.

A. Evaluation Criteria

The evaluation criteria utilized are those outlined in Chapter 3 and used throughout this report: effectiveness, efficiency, equity, flexibility, and implementability. As shown in Table 12-13, each criterion can be defined in terms of energy facility siting issues. These criteria reflect the types of tradeoffs that policymakers must consider when energy resource development involves siting new facilities. Although it would probably be impossible to choose an alternative or implementation strategy which ranks high on all five criteria, this assessment is intended to provide information regarding the consequences of different policy choices.

As suggested by Table 12-13, the five evaluative criteria address the two policy objectives outlined in Section 12.3.1: to site energy facilities in locations that will not result in unacceptable costs and risks; and to provide the means for interested parties to participate in siting decisions without causing unreasonable delays. Many of the measures in Table 12-13 would require a separate, major study to estimate comprehensively. Thus, the assessment that follows is a qualitative evaluation of the policy alternatives.

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[1] Metz, William D. "Nuclear Licensing: Promised Reform Miffs All Sides of Nuclear Debate." Science, Vol. 198 (November 11, 1977), p. 590.

[2] See Davis, Thomas P. "Citizen's Guide to Intervention in Nuclear Power Plant Siting: A Blueprint for Alice in Nuclear Wonderland." Environmental Law, Vol. 6 (Spring 1976), pp. 621-74.

TABLE 12-13: CRITERIA FOR EVALUATING ENERGY FACILITY SITING ALTERNATIVES

CRITERIA	AS APPLIED TO SITING	MEASURES
Effectiveness Achievement of Policy objectives	Does it achieve the objectives of siting energy facilities in locations that will not result in unacceptable costs and risks, and provide the means for interested parties to participate in siting decisions without causing unreasonable delays?	Quantitative: Number of acceptable sites identified for new energy facilities Time taken between initial proposal and when facility is brought "on-line" Qualitative: Level of citizen participation allowed The level, kind, and location (both geographically and socially) of impacts resulting from a siting decision, such as: (a) health impacts (b) ecological impacts (c) economic impacts (d) aesthetic impacts
Efficiency Costs, benefits, and risks	Are the least costly sites for new energy facilities chosen without risking environmental damage, human health, and socioeconomic impacts? Do the costs of accommodating different participants in the siting process exceed the costs of delay if opposition arises because such participation is not included? Do the costs of designing the facility to limit emissions exceed the costs of delay if such modifications are not initially made?	Quantitative The cost of energy production from facilities (dollars per British thermal unit) The cost of shortages in dollars and unemployment levels if energy shortfalls result from delays, cancellations, or choice of alternate sites The amount of money and time spent in complying with regulations in order to obtain permits Qualitative: Risk of widespread opposition to siting alternatives

TABLE 12-13: (Continued)

CRITERIA	AS APPLIED TO SITING	MEASURES
Equity Distribution of costs, benefits, and risks	Does the area receiving the benefits (energy, employment, etc.) also bear the costs and risks of the required energy facility?	Quantitative: Costs of energy in demand area Taxes, revenues, impact assistance, and other financial benefits felt in supply area Qualitative: Impacts felt in areas where the facility is sited and where energy is received Determination of winners and losers in siting process
Flexibility Adaptability to local conditions and times	Will the alternative still be applicable if laws, institutiions, and social goals change? Will the alternative still be applicable if regional and local attitudes change? Is the alternative capable of incorporating the conditions of unique site-specific cases?	Quantitative: The number of permits which must be obtained The number of agencies which must be involved in the permitting process The number and variety of interest groups (both within and outside the region) that have input into the siting process Qualitative: Adaptability (high, medium, or low) Adjustability (high, medium, or low)
Implementability Possibility of being adopted	Will the alternative be implemented through standards or through adjudication in the courts? Does the alternative oppose or violate the goals or objectives of power-interest groups or institutions?	Quantitative: Number and type of permits which must be obtained Number and type of agencies which must be involved Qualitative Views of powerful politicians and interest groups in the West and other areas Support from key individuals in citizen groups and other parties-at-interest

B. Evaluation of Undertaking Technology-Site Evaluations

(1) How Effective Is This Option?

This category of alternatives is based on the knowledge that some technology-location combinations will result in more undesirable risks than others and that those combinations which result in high levels of impacts can be excluded. The assumption is that the remaining sites will be acceptable locations for energy development facilities. To the extent that sufficient sites can be identified to meet the new energy needs projected for this study, the technology-site evaluation option can be effective.

However, there are a number of problems which severely limit the effectiveness of attempts to use zoning approaches, classification schemes, screening methods, or site banking techniques. The effectiveness of technology-site evaluation is dependent on developing a selection method which can eliminate areas as possible locations for energy facilities on the basis of several objective criteria. Each stage of the technology-site evaluation could then eliminate those locations that failed to meet a particular standard, and when all the unacceptable locations for each criterion were identified, the remaining sites would be regarded favorably by all parties-at-interest. However, technology-site evaluation could possibly exclude most (or all) areas from future energy development. That is, since each possible technology-location combination will have serious impacts, no particular configuration may be acceptable if all evaluation standards are invoked simultaneously. For example, a process which eliminated all national parks, wilderness areas, and wildlife refuges[1] as a first step, and then eliminated areas with severe water problems, regions with air dispersal problems, and locations that form the critical habitat of endangered or threatened species might leave few sites for energy development.[2] Thus, in order for the technology-site evaluation strategy to be an effective policy option, policymakers will have to choose evaluation criteria in a manner which provides sufficient energy sites to meet the needs projected in this study.

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[1] These areas are currently excluded as possible sites for new energy facilities according to the terms of the Federal Coal Leasing Amendments Act of 1975, Pub. L. 94-377, 90 Stat. 1083.

[2] See U.S., Nuclear Regulatory Commission, Office of Special Studies. Nuclear Energy Center Site Survey--1975, 5 parts, plus Executive Summary and Appendix. Springfield, Va.: National Technical Information Service, 1976.

(2) Is the Alternative Efficient?

Depending on the amount of area exluded from siting, technology-site evaluation appears to be a relatively efficient policy alternative. Although the use of site screening or other approaches could increase some costs of energy development by eliminating locations on the basis of noneconomic (chiefly environmental) criteria, an early determination of acceptable sites should reduce other costs by reducing the likelihood that energy facilities will be proposed in areas where widespread public opposition exists. Thus, although some "least-cost" locations will be excluded from consideration, if technology-site evaluation is implemented judiciously it could reduce the costs of siting new energy facilities because delays would be eliminated by removing "troublesome" sites at an early stage. For instance, early site screening might have ruled out the Kaiparowits site in southern Utah as a candidate area for new energy facilities. The site has eight national parks within a 200-mile radius, and the use of technology-site evaluation techniques might have ruled such an environmentally sensitive region unacceptable for energy development. Since the sponsors had spent more than $20 million by the time the project was cancelled, the use of technology-site evaluation could have been an efficient option.[1]

(3) How Are Costs and Benefits Distributed?

Technology-location evaluation should make siting more equitable in the sense that no locality will have to bear excessively large impacts of energy development. If the areas with the largest costs and greatest risks are eliminated through the use of screening or some other evaluative technique, then facilities sited in the remaining locations should impose fewer environmental and socioeconomic burdens on residents. But these represent only gross improvements in the distribution of costs and risks. The state-of-the-art in technology-site evaluation does little to determine the gains and losses for specific groups; about the best that can be done is to "make trade-offs between costs and benefits so as to improve the equity of the decision without sacrificing unduly the interests of the majority of the affected parties."[2] The identification of the "winners" and "losers" in the selection of siting through consideration of public values and attitudes, is still at a primitive stage. Standards such as the significance of an energy development to the "public interest" or to a particular interest group or individual have yet to be developed. But the evaluation of the distribution of impacts is highly dependent on answering the question: "Important to whom?" The displacement of even 20 families in a sparsely populated area of the West may have dramatic and far-reaching economic and social consequences; technology-site evaluations remain relatively insensitive to these kinds of consequences of energy development activities.

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[1] Myhra, David. "Fossil Projects Need Siting Help Too." Public Utilities Fortnightly, Vol. 99 (September 29, 1977), p. 25.

[2] Spangler, Miller B. "Environmental and Social Issues of Site Choice for Nuclear Power Plants." Energy Policy, Vol. 2 (March 1974), p. 24.

(4) Is the Option Flexible?

Technology-site evaluation is not a highly flexible alternative. Evaluative criteria are based on social, political, technological, and financial conditions which change rapidly over time. Unless areas are assessed periodically to determine the appropriateness of their status, locations may be incorrectly included in or excluded from development. Sophisticated technology-site evaluations may require several iterations in which different and/or additional criteria are used. For example, information gathered in a particular location regarding the quantity and quality of water may trigger a need for data about the location of water supplies relative to their sources.[1] Such modifications are costly both in terms of time and money, and these evaluations must be adjusted to correspond to the characteristics of various technologies. Delineating rigid buffer zones of a certain radius, for instance, may exclude sites from consideration that would otherwise be acceptable for technologies with stricter performance standards.

The flexibility of this alternative is also constrained by the availability of adequate evaluative information, since technology-site evaluation can only be applied on the basis of criteria for which data are available. For instance, water availability, predominant land uses (intensive agriculture, specialty crops, etc.), known habitats of threatened species, population densities, and land ownership patterns are examples of phenomena for which there may be adequate data and which can be used as a basis for excluding certain impact-prone regions as sites for energy facilities. But large-scale technology-site evaluation is no substitute for an in-depth analysis of the specific impacts which may arise from the interaction of an energy technology with its particular location. Unfortunately, much of the information needed to determine which technology-location combinations are acceptable is lacking. Baseline data on many energy technologies are still unavailable and it is not yet possible to determine reliably the level of residuals from commercially operating facilities. In addition, models which trace the impacts of energy facilities, such as the Gaussian air dispersion models, are subject to high levels of uncertainty.

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[1] Keeney, Ralph L., and Keshavan Nair. "Nuclear Siting Using Decision Analysis." Energy Policy, Vol. 5 (September 1977), p. 225.

(5) Is the Option Implementable?

The implementability of techniques such as site screening is handicapped by opposition from several sectors. First, resistance can be expected to develop against any technology-site evaluation which runs counter to local and state interests and values. Thus, any site selection conducted by the federal government is particularly vulnerable to local concerns about "outside" studies. Localities can be expected to focus opposition on such factors as land speculation following the identification of acceptable areas. Second, technology-site evaluation may be difficult for utilities or other energy developers to accept, given the lack of precision involved in much of the cost-benefit data. Sponsors of energy projects may also object to the inclusion of noneconomic data in the evaluative process.[1] Finally, there is a widespread perception among participants in the energy facility siting process that technology-site evaluations are "administrative charades" characterized by "pseudoscientific cost-benefit jargon."[2]

In addition, the implementation of the technology-site evaluation option will have to facilitate federal-state relationships. Encouraging and discouraging certain technology-location combinations can be implemented through federal and/or state actions. Many federal laws already lead to the explicit or implicit exclusion of parks, monuments, wilderness lands, and wildlife areas from new energy facility siting. Another example of the implicit federal site screening is the 1977 CAA Amendments' exclusion of certain sites from consideration--international parks of any size, national parks over 6,000 acres, and national wilderness areas in excess of 5,000 acres have been designated Class I PSD areas.[3] Thus, the West has many large areas for which the air quality standards are high. Although the delineation of rigid clean air "buffer zones" is not defined within the CAA Amendments, the implementation of the act will result in the development of implicit exclusion zones surrounding the Class I areas for certain types of facilities. Permission would be denied for a site that, according to air quality modeling, could be expected to violate Class I PSD increments in nearby Class I areas. This is one example of federal institutions already in place that could mandate or prohibit certain technology-location combinations. And in some cases, this authority has been exercised. The difficulty with these policies is that direct use of technology-site evaluation by the federal government has preempted some state efforts toward determining exclusionary areas. Officials in Utah, for example, have expressed dissatisfaction with the preemptive implications of the CAA Amendments which, according to the state view, stymie efforts to develop energy resources.[1] Thus, technology-site evaluation implemented at the federal level may not reduce the lead time in bringing new facilities on-line because of state resistance.

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[1] Muntzing, L. Manning. "Siting and Environment: Towards an Effective Nuclear Siting Policy." Energy Policy, Vol. 4 (March 1976), pp. 6-7.

[2] See Joskow, Paul L. "Approving Nuclear Power Plants: Scientific Decisionmaking or Administrative Charade." Bell Journal of Economics and Management Science, Vol. 5 (Spring 1974), pp. 320-32.

[3] See Kirschten, J. Dicken. "The Clean Air Conference--Something for Everybody." National Journal, Vol. 9 (August 13, 1977), pp. 1261-63.

(6) Summary of Alternatives to Encourage and Discourage Certain Technology-location Combinations

Findings for the evaluation of each alternative for encouraging and discouraging certain technology-location combinations are presented in Table 12-14. Each of the alternatives analyzed--designating acceptable and unacceptable technology-location combinations and implementing site screening and site banking techniques--would encourage the selection of some sites in the West for energy development and discourage others.

Since neither specific alternative meets all five evaluative criteria simultaneously, policymakers will have to trade off the effectiveness, efficiency, equity, flexibility, and implementability of the two alternatives. For example, if policymakers wish to designate an absolute minimum number of sites for new energy development in the West, they will need to employ selection criteria judiciously and in varying combinations in order to ensure against eliminating every possible site from consideration. However, if the major concern of policymakers is to designate sites that are acceptable to the public, they may have to eliminate some "least-cost" sites, even if such choices contribute to high energy costs.

C. Evaluation of Employing Impact Assistance Methods

(1) How Effective Is This Option?

This category of alternatives aims at reducing the undesirability of energy projects at selected locations through impact assistance efforts, either mitigation or compensation. It can be a moderately effective means of siting energy facilities without unacceptable costs and risks if the intergovernmental jurisdiction problems involved in ameliorating development impacts are resolved. However, the federal-state-local government coordination bottlenecks which characterize the financing and management of energy

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[1] Gill, Douglas. "Utah Seeks Federal Okay to Set Own Pollution Level." Denver Post, December 19, 1976.

TABLE 12-14: A SUMMARY EVALUATION OF ENCOURAGING AND DISCOURAGING CERTAIN TECHNOLOGY-LOCATION COMBINATIONS

CRITERIA	MEASURES	FINDINGS
Effectiveness How effective will technology-site evaluation be in siting energy facilities in locations that will not result in unacceptable costs and risks or unnecessary delays?	Number of acceptable sites identified for new energy facilities	Technology-site evaluation may eliminate many sites from consideration for energy development
	Time taken to bring new energy facilities on line	Technology-site evaluation will not expedite the siting process due to information gaps and federal-state implementation conflicts
Efficiency What will be the costs, benefits, and risks associated with technology-site evaluation?	Costs of energy production	Technology-site evaluation will increase the costs of development by eliminating some "least-cost" locations
	Risks of widespread opposition	Technology-site evaluation will decrease the risks associated with siting by eliminating areas which feature widespread public opposition
Equity How will these costs, benefits, and risks be distributed?	Distribution of costs and benefits	Technology-site evaluation does not enable an accurate determination of the groups which are the "winners" and "losers" from siting decisions
	Distribution of impacts	Technology-site evaluation will reduce the greatest costs and risks of development so that no locality will have to bear excessively large impacts

TABLE 12-14: (Continued)

CRITERIA	MEASURES	FINDINGS
Flexibility How adaptable and adjustable is technology-site evaluation to changing conditions and times?	Adaptability	Technology-site evaluation requires frequent modifications and updating to maintain accurate criteria
	Adjustability	Technology-site evaluation iterations are expensive both in terms of time and money
Implementability How difficult will it be to implement technology-site evaluation?	Acceptability	Technology-site evaluation suffers from perceptions of lack of precision and an environmental, noneconomic bias
	Ease of administration	Technology-site evaluation will be opposed by state and local interests if findings are at variance with their values

impact assistance programs could cancel any gains made by reducing resistance to facility siting through mitigation or compensation strategies. There is general agreement that both compensatory and ameliatory efforts are best monitored and administered at the local level, because localities are more sensitive to the costs, benefits, and risks of energy development for particular segments of the population and because "local government has a primary responsibility to see that the new growth and development in a community pays a fair share of the community support systems in a manner which will not place an unfair burden upon original local residents."[1] But most local governments are poorly equipped to monitor and manage the impacts of new energy facilities. Federal and state legislative and regulatory constraints limit the capabilities of local communities to finance mitigation programs, and states have been reluctant to equip local jurisdictions with sufficient authority (such as revenue sharing powers) to respond to impacts. Moreover, states themselves have been slow to develop institutions that could assist in ameliorating the adverse consequences of siting decisions, and federal programs often have been characterized by inadequate funding, an inability to anticipate or acknowledge impact conditions, and overly complex and time-consuming financial aid application procedures.[2]

It should be emphasized that reducing the burden of impacts on affected citizens or making amends for impacts by offering tangible benefits can eliminate some costs and risks of energy facility siting. But to be effective, mitigation and compensation strategies must provide states and localities: (1) "front end" support before impacts arise; (2) revenue-generating approaches applicable to energy resources on federal lands (to which property taxes do not apply); (3) planning capabilities, including information collection and analysis tools; and (4) risk-sharing options which provide for "boom" as well as "bust" scenarios.[1]

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[1] Monaghan, James E. "Managing the Impacts of Energy Development: A Policy Analysis from a State Government Perspective," in U.S., Congress, House, Committee on Interstate and Foreign Commerce, Subcommittee on Energy and Power; and Senate, Committee on Energy and Natural Resources and the National Ocean Policy Study of the Committee on Commerce. Project Interdependence: U.S. and World Energy Outlook Through 1990, Committee Print. Washington, D.C.: Government Printing Office, 1977, p. 609.

[2] Valeu, Robert L. "Financial and Fiscal Aspects of Monitoring and Mitigation." Paper presented at the Symposium in State-of-the-Art Survey of Socioeconomic Impacts Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977, p. 12.

(2) Is the Alternative Efficient?

Adopting mitigation or compensation policy alternatives is a costly commitment. The federal government has established a $1.2 billion grant and loan fund as part of the Coastal Energy Impact Program alone, and impact assistance at a single site can require substantial financial investments. For example, the mitigation of impacts at the Colstrip power project in Montana included a housing investment of about $2 million.[2] Given the relatively ineffective governmental apparatus discussed above, the administration of programs designed to alleviate the burdens of energy development may be very inefficient. But evaluating the administrative efficiency of impact assistance efforts is too narrow a focus--the true test of an efficient mitigation or compensation program is whether the cost of making these investments is outweighed by the reduced risks of opposition to energy projects. Thus, in the case of making compensation payments to affected citizens, "such payments may not be worth their administrative costs on ground of fairness alone, but if their omission means that a valuable project is cancelled entirely for want of a community willing to accept it, a strong efficiency argument is applicable."[3] If local communities could be reimbursed for the identifiable socioeconomic and environmental side-effects of development, many of the costs of energy production resulting from project delays or cancellations could be decreased. And, impact assistance could reduce the time and money spent in the litigation procedures which today are still the major compensatory avenues for participants in many siting decisions.[1]

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[1] Heintz, H. Theodore, Jr. "The Government Role in Mitigating Impacts of Energy Development." Paper presented at the Symposium on State-of-the-Art Survey of Socioeconomic Impacts Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977, pp. 4-6; see also Breese, Gerald, *et al*. *The Impact of Large Installations on Nearby Areas: Accelerated Urban Growth*. Beverly Hills, Calif.: Sage Publications, 1967.

[2] White, Martin. "Colstrip Power Project--Its Monitoring and Mitigation Program." Paper presented at the Symposium on State-of-the-Art Survey of Socioeconomic Impacts Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977, pp. 4-6.

[3] O'Hare, Michael. "'Not on *My* Block You Don't': Facility Siting and the Strategic Importance of Compensation." *Public Policy*, Vol. 25 (Fall 1977), p. 429.

(3) How Are Costs and Benefits Distributed?

Impact assistance strategies are designed to reduce the local inequities which flow from the siting of new energy facilities (see the discussion of the proposed Energy Impact Assistance Act of 1978 in Chapter 9). Some citizens will be required to shoulder an unequal share of the burden of providing energy resources to the general population if the adverse consequences of development are not compensated for or mitigated. Therefore, the crucial standard for this category of policy alternatives for employing impact assistance methods is the degree to which these costs and risks are distributed in an equitable manner among the affected parties. Overall, mitigation and compensation efforts provide an equitable solution to the siting dilemma. Impact aid is perhaps the only policy alternative which can decisively and equitably site major facilities despite the local costs they can be expected to incur. But some serious caveats are in order regarding the equity of mitigation and compensation measures. First, equity does not imply equality--no impact assistance strategy will be able to reduce the costs and risks of development without some participants being overprotected or undercompensated. Second, even approaching an equitable diffusion of the negative impacts of facility siting requires an extremely sensitive set of political and administrative institutions. Being able to identify secondary and future costs, such as rising insurance premiums or declining land values, as well as those citizens to be affected by them, will determine the ultimate success or failure of mitigation or compensation schemes which require substantial lead time.[2]

(4) Is the Option Flexible?

In isolation, any single legislative impact assistance approach or any particular agency's predictive impact model are not flexible alternatives for siting energy facilities. As the federal government's response to the socioeconomic impacts resulting from energy development has evolved toward the use of multiple impact assistance tools and as state and local governments have come to appreciate the diversity of costs and risks associated with energy facility siting, however, mitigation and compensation efforts have become more flexible. An example of how compensatory or ameliatory programs have been made more adaptable to changing conditions and times is the "impact team." As used in Sweetwater County, Wyoming, and Moffat County, Colorado, these teams of officials from local, state, and federal governments and private industry have been assembled to monitor energy development and its impacts. Recent experience indicates that "the functioning of such impact teams does a great deal to head off conflict and reduce citizen antagonism over resource development.[1]

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[1] See Horowitz, Donald L. "The Courts as Guardians of the Public Interest." Public Administration Review, Vol. 37 (March/April 1977), pp. 148-54.

[2] Heintz, H. Theodore, Jr. "The Government Role in Mitigating Impacts of Energy Development." Paper presented at the Symposium on State-of-the-Art Survey of Socioeconomic Impacts Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977, pp. 6-8.

(5) Is the Alternative Implementable?

The implementability of most impact assistance options is relatively low. Several major obstacles stand in the way of implementing mitigation and compensation programs. First, no matter how detailed the underlying planning process, compensation measures are notorious for attracting "free riders" who "join in the clamor of opposition to a project, making it appear that the numbers of people to be compensated in order to secure timely energy development are quite large" in order to share in the benefits of impact assistance.[2] Second, impact assistance does little to resolve the problem of opposition to siting from interests outside the local community. Although there is at least the possibility that compensation measures might deprive "outside" environmentalists of "allies" within the affected community, neither mitigation nor compensation schemes are likely to overcome resistance to energy development by organized environmental advocates. If for no other reason than that the goals of these groups are focused on the elimination of the kinds of environmental externalities to which existing impact assistance techniques are not easily applicable, the presence of environmental interest groups poses a barrier to the implementation of comprehensive mitigation or compensation programs.[1]

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[1] Monaghan, James E. "Managing the Impacts of Energy Development: A Policy Analysis from a State Government Perspective," in U.S., Congress, House, Committee on Interstate and Foreign Commerce, Subcommittee on Energy and Power; and Senate, Committee on Energy and Natural Resources and the National Ocean Policy Study of the Committee on Commerce. Project Interdependence: U.S. and World Energy Outlook Through 1990, Committee Print. Washington, D.C.: Government Printing Office, 1977, pp. 608-29.

[2] Heintz, H. Theodore, Jr. "The Government Role in Mitigating Impacts of Energy Development." Paper presented at the Symposium on State-of-the-Art Survey of Socioeconomic Impacts Associated with Construction/Operation of Energy Facilities, St. Louis, Missouri, January 1977, pp. 6-7.

In addition, the current structure for providing federal impact assistance is ill-equipped to provide mitigatory or compensatory aid as a siting strategy. The federal government has a number of ongoing impact assistance programs, including profit sharing with the states from royalties or other development revenues, or targeting assistance to the impacts themselves (as in the 1976 Coastal Zone Act Amendments[2]), and some existing energy programs have been modified to provide impact assistance; however, the federal government basically is limited to a complementary role of providing back-up loans, loan guarantees, or grants. But this elaborate and essential support system is highly fragmented; no single federal agency has been designated as the triggering mechanism for providing energy impact assistance. As a result, at least four cabinet-level departments (Commerce, Energy, Interior, and Housing and Urban Development) and various other regulatory and coordination agencies have major responsibilities in the area of impact mitigation. This administrative compartmentalism restricts the planning process which underlies impact assistance programs, and it can restrict agency decisionmaking by leading to bureaucratic stalling or "buck-passing" in the face of citizen opposition to siting proposals.

An example of the problems confronting effective impact assistance in the West is the difficulty encountered with the 1976 Federal Land Policy and Management Act.[3] Under the terms of this legislation, state and local governments were allowed to borrow against projected mineral lease revenues to respond to the socioeconomic impacts of energy development. However, a number of western states, including Colorado, Utah, and Wyoming, have constitutional provisions which prohibit their participation in loan guarantee programs that present the possibility of fiscal overextension by using future revenues before they are actually generated. Conservative restrictions of this type are understandable, given the fact that many federal supports may actually increase siting uncertainty and risk for states and localities.[1]

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[1] O'Hare, Michael. "'Not on My Block You Don't': Facility Siting and the Strategic Importance of Compensation." Public Policy, Vol. 25 (Fall 1977), pp. 450-51.

[2] Coastal Zone Management Act Amendments of 1976, Pub. L. 94-370, 90 Stat. 1013.

[3] Federal Land Policy and Management Act of 1976, Pub. L. 94-579, 90 Stat. 2743, 43 U.S.C. 1701 et seq.

(6) Summary of Alternatives to Employ Impact Assistance Methods

Findings resulting from the evaluation of each alternative for employing impact assistance methods are summarized in Table 12-15. Both alternatives discussed here--requiring impact mitigation by developers, state or federal governments or compensating state and local governments for impacts--would reduce public opposition to some energy development sites in the West.

The previous evaluation discussion reveals that the five criteria used in this study--effectiveness, efficiency, equity, flexibility, and implementability--can seldom, if ever, be met simultaneously. Policymakers will have to trade off the accomplishment of one criterion against the achievement of some other measure. For example, impact assistance required from developers or made available by the federal government would reduce the opposition at some sites, if such aid is provided sufficiently in advance of development to allow local officials to cope with public service needs. In addition, impact assistance can serve to distribute the costs of energy development more equitably among the adversely affected or benefiting parties. But the administrative costs of impact assistance are high and will contribute to higher energy prices. Furthermore, the impact assistance alternative cannot be adapted very well to changing circumstances without using local response mechanisms such as impact teams. And the high acceptability of impact assistance makes it a tempting target for "free riders" who seek quick gains from this alternative.

D. Evaluation of Increasing Citizen Involvement in Siting Decisionmaking

This evaluation focuses on the category of alternatives for increasing citizen involvement in siting decisions. However, because of the wide range of participation options it is necessary to point out the variations among the three specific alternatives included in this category. In fact, the three specific participation alternatives described earlier in this chapter represent

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[1] Monaghan, James E. "Managing the Impacts of Energy Development: A Policy Analysis from a State Government Perspective," in U.S., Congress, House, Committee on Interstate and Foreign Commerce, Subcommittee on Energy and Power; and Senate, Committee on Energy and Natural Resources and the National Ocean Policy Study of the Committee on Commerce. Project Interdependence: U.S. and World Energy Outlook Through 1990, Committee Print. Washington, D.C.: Government Printing Office, 1977, pp. 608-29.

TABLE 12-15: A SUMMARY EVALUATION OF REDUCING THE UNDESIRABILITY OF ENERGY FACILITIES AT CHOSEN SITES

CRITERIA	MEASURES	FINDINGS
Effectiveness How effective will impact assistance be in siting energy facilities in locations that will not result in unacceptable costs and risks or unnecessary delays?	Number of acceptable sites identified for energy facilities	Impact assistance will reduce the opposition to some sites, but serious intergovernmental financing bottlenecks could cancel these gains
	Time taken to bring new energy facilities on line	Impact assistance will not expedite the siting process unless the previous lack of "front end" federal support and poor state and local planning capabilities are overcome
Efficiency What will be the costs, benefits, and risks associated with impact assistance?	Costs of energy production	Impact assistance features high administrative costs which will increase the costs of energy development
	Risks of widespread opposition	Impact assistance should reduce the risks and uncertainty associated with citizen resistance and litigation
Equity How will these costs, benefits, and risks be distributed?	Distribution of costs and benefits	Impact assistance is the best method of distributing the costs of development
	Distribution of impacts	Impact assistance may impose additional risks on localities unless it is targeted specifically to areas with heavy impacts and is provided with sufficient lead time

TABLE 12-15: (Continued)

CRITERIA	MEASURES	FINDINGS
Flexibility How adaptable and adjustable is impact assistance to changing conditions and times?	Adaptability	Impact assistance is not very adaptable to changing circumstances unless local response mechanisms such as "impact teams" are utilized
	Adjustability	Impact assistance requires the use of multiple tools which are substitutable without adding an overwhelming cost to development
Implementability How difficult will it be to implement impact assistance?	Acceptability	Impact assistance may be too inviting a target for "free riders" and other opportunists who seek to gain economic benefits from the program
	Ease of administration	Impact assistance will do little to reduce the resistance to development of "outside" interests who have different policy goals and who stand to gain nothing from mitigation or compensation efforts

a continuum of actual policymaking power, from information exchange through administrative interaction to decisionmaking input. In general, the greater the power-sharing responsibilities vested in citizens' groups, the more effective, efficient, and equitable are these alternatives for the objectives outlined above. On the other hand, as public access to the levers of power decreases, the flexibility and implementability of alternatives is enhanced.

(1) Is This Category of Alternatives Effective?

The category of public participatory alternatives can contribute to the policy objective of siting energy facilities with a minimum of risks and delays. Information exchanges between the public and siting agencies (through participation audits or improvements in public hearing procedures) are capable of reducing the delays involved in data searches and could provide greater bases for consensus-building among citizens' groups. However, the effectiveness of administrative interaction mechanisms, such as citizen advisory committees, is limited by their inability to serve as little more than a generator of "trial balloons," since such committees have no binding decisionmaking authority. These institutions do provide a major channel of communication between professional administrators and the public, but despite their widespread acceptance by government, they possess no real standing or sanctions by which to ensure representation. Two fundamental problems plague interaction mechanisms: some interest groups have complained that their own limited resources constrain their ability to participate actively through these avenues (a deficiency which has led to much of the demand for participation process support alternatives, discussed below), and even if groups are able to make their interests known through such policy forums, there is absolutely nothing which guarantees that recommendations will be heeded.[1]

Allowing citizens direct access to decisons affecting facility siting, on the other hand, is a relatively effective means of reducing the costs associated with development resistance. Much more accurate and meaningful signals of public preferences can be sent to policymakers in less time through the use of review boards or citizen lawsuits than is the case with other participatory options. But precisely because review boards involve the sharing of power there is a high degree of entrenched opposition to public decisionmaking input on the part of those in government.[1]

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[1] Doerksen, Harvey R., and John C. Pierce. "Citizen Influence in Water Policy Decisions: Context, Constraints, and Alternatives." Water Resources Bulletin, Vol. 11 (October 1975), pp. 953-64; and Deli Priscoli, Jerry. "Citizen Advisory Groups and Conflict Resolution in Regional Water Resources Planning." Water Resources Bulletin, Vol. 11 (December 1975), pp. 1233-43.

(2) Is the Alternative Efficient?

Participation alternatives can be moderately efficient. In particular, administrative costs would be low and in some cases these would be borne by participating agencies or groups. An early consensus on site choices would decrease the possibility of lengthy delays in the siting process and thus reduce energy production costs. However, the need to satisfy a wide range of interested parties could also result in siting choices which are more expensive than would otherwise be the case.

Low administrative costs of the participation alternatives would, however, be offset by the costs of data exchanges. Whether data are purchased by government, generated by agencies, or provided by the participants themselves, they are expensive to collect, monitor, and assess.[2] Data exchange options also suffer from the possibility that they will lead to "information overload" for both the agencies and the public participants involved in facility siting, since the information which can be used efficiently by any decisionmaker is limited both in terms of its quality and quantity.[3] This is particularly the case for legalistic or highly technical data of the type generated through public hearings.[4] Interest goups with little experience in participating in scientific and technological decisions may be overwhelmed even by procedures designed to make hearings meaningful.

Finally, the costs of litigation have become one of the major obstacles to the establishment of a rational national energy facility siting policy. Lawsuits involve problems of securing and paying for scientific and technical expertise, and there are extensive delays required to carry many legal actions through to their conclusion. Moreover, judicial decisionmaking may be very uneven, since cases are not chosen on the basis of a systematic approach to a problem. Also lawsuits are decided in a special way: the adversary process, featuring examination in a confrontation atmosphere, is not noted for its efficient resolution of issues.[1]

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[1] See Arnstein, Sherry R. "Maximum Feasible Manipulation." Public Administration Review, Vol. 32 (July/August 1972), pp. 377-90.

[2] See Ingram, Helen. "Information Channels and Environmental Decision Making." Natural Resources Journal, Vol. 13 (January 1973), pp. 150-69.

[3] Carver, John A. "Energy Information, and Public Policy." American Behavioral Scientist, Vol. 19 (February 1976), p. 280.

[4] See Heberlein, Thomas A. "Some Observations on Alternative Mechanisms for Public Involvement: The Hearing, Public Opinion Poll, the Workshop, and the Quasi-Experiment." Natural Resources Journal, Vol. 16 (January 1976), pp. 197-212.

(3) How Are Costs and Benefits Distributed?

Most participatory mechanisms are fairly equitable siting policy alternatives. Used in conjunction with participation process support techniques, information exchange options offer a highly equitable mechanism for citizen involvement. Equal access to data in public hearings, for example, can remove many of the participatory advantages enjoyed by small, well represented groups which may use information strategically to transfer the risks of development to large, poorly represented groups.[2] And while most interaction alternatives, such as advisory committees, are not really representative of participants, greater care in the selection of members can lead to relatively equitable public involvement avenues. Choosing participants on an advisory committee by another citizen participation mechanism, such as public hearings, could reduce perception of agency control or establishment bias.[3] Much the same membership selection requirements characterize direct citizen input options such as citizen review boards, where it is difficult to structure a body which is fully representative of the population served but where minority views can be guaranteed through careful recruitment practices.

(4) Is the Option Flexible?

One of the greatest strengths of methods of increasing public participation in siting decisions is their flexibility. Increasing information flows in the siting process does raise the possibility that any particular siting alternative will be associated with adverse consequences identified by new data, thus increasing the bias toward the status quo. Without information dissemination and collection efforts, however, public reaction to any siting option will be unclear, and policymakers will have little sense of the flexibility available to them in making acceptable siting choices. Both administrative interaction and direct public input alternatives cover a range of organizational forms. The traditional use of public hearings, advisory committees, and citizen review boards has been somewhat ritualistic and legalistic in the past, but earlier timing and broader citizen involvement has led to more exploratory, flexible procedures.[1]

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[1] Sive, David. "The Role of Litigation in Environmental Policy: The Power Plant Siting Problem." Natural Resources Journal, Vol. 11 (July 1971), pp. 470-96.

[2] See Frauenglass, Harvey. "Environmental Policy: Public Participation and the Open Information System." Natural Resources Journal, Vol. 11 (July 1971), pp. 495-96.

[3] See Cronin, Thomas E., and Norman C. Thomas. "Federal Advisory Processes: Advice and Discontent." Science, Vol. 173 (February 26, 1971), pp. 771-79.

(5) Is the Option Implementable?

Public participation alternatives can be implemented more easily than most other options. Demands for public involvement in facility siting decisions have made information exchange and administrative interaction mechanisms almost an automatic governmental response. Hearings and advisory committees, for example, are found at all levels of government and with functions ranging from general data collection through the provision of scientific and technical expertise, to conducting special studies for particular clientele groups.[2] And litigation continues to be a highly implementable strategy; the role of the courts in facility siting policy has expanded rapidly as the judiciary has moved from a focus on the protection of the rights of parties-at-interest to a more comprehensive interest in the problems of direct public participation and the more general "public interest" issues of locating energy facilities.[3]

(6) Summary of Alternatives for Increasing Citizen Involvement in Siting Decisionmaking

Evaluative findings for each alternative that would increase citizen involvement in siting decisionmaking are presented in Table 12-16. Delays involved in site selection and approval

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[1] Bishop, A. Bruce, Mac McKee, and Roger D. Hansen. Public Consultation in Public Policy Information: A State-of-the-Art Report, for Energy Research and Development Administration. N. p.: Intermountain Consultants and Planners, Inc., 1978, pp. 43-61.

[2] Brown, David S. "The Management of Advisory Committees: An Assignment for the '70s." Public Administration Review, Vol. 32 (July/August 1972), pp. 334-42; and Heberlein, Thomas A. "Some Observations on Alternative Mechanisms for Public Involvement: The Hearing, Public Opinion Poll, and Workshop, and the Quasi-Experiment." Natural Resources Journal, Vol. 16 (January 1976), pp. 197-212.

[3] See Wolpert, Julian. "Regressive Siting of Public Facilities." Natural Resources Journal, Vol. 16 (January 1976), pp. 103-15; and Horowitz, Donald C. "The Courts as Guardians of the Public Interest." Public Administration Review, Vol. 37 (March/April 1977), pp. 148-54.

TABLE 12-16: A SUMMARY EVALUATION OF INCREASING CITIZEN INVOLVEMENT IN SITING DECISIONMAKING

CRITERIA	MEASURES	FINDINGS
Effectiveness How effective will public participation be in siting energy facilities in locations that will not result in unacceptable costs and risks or unnecessary delays?	Number of acceptable sites identified for new energy facilities	Public participation will legitimize positions already held, whether in opposition to or support of sites.
	Time taken to bring new energy facilities on-line	Public participation, particularly direct citizen input, could reduce the delays involved in site selection and approval.
Efficiency What will be the costs, benefits, and risks associated with public participation?	Costs of energy production	Public participation is moderately efficient. Administrative costs are low, but information exchange and litigation are very expensive.
	Risks of widespread opposition	Public participation reduces policy uncertainties and risks for citizens' groups.
Equity How will these costs, benefits, and risks be distributed?	Distribution of costs and benefits	Public participation options, if used in conjunction with participation process support alternatives, are an equitable means of distributing siting costs.
	Distribution of impacts	Public participation can equalize the risks of development between small, well represented groups and large, poorly represented ones.

TABLE 12-16: (Continued)

CRITERIA	MEASURES	FINDINGS
Flexibility How adaptable and adjustable is public participation to changing conditions and times?	Adaptability	Public participation offers an almost unlimited range of options, including information exchange, administrative interaction, and direct citizen input.
	Adjustability	Public participation provides an exploratory capability for siting decisions, if implemented early in the siting process.
Implementability How difficult will it be to implement public participation?	Acceptability	Public participation has become an almost automatic government response and enjoys a high degree of legitimacy among both agencies and interest groups.
	Ease of administration	Public participation options, once in place, often prove difficult to administer, due to bureaucratic resistance and inertia, public apathy, and changing situations.

could be reduced by implementing any of the following three specific alternatives in this category:

- Provide for information exchanges between participants and agencies;
- Encourage administrative interaction between agencies and participants;
- Allow direct participant input into agency decisions.

Significantly, however, reduction in site selection and approval delays can usually be achieved only by making trade-offs among the five criteria. When policymakers attempt to increase citizen involvement in siting decisionmaking, they will need to know the consequences of choosing one criterion or a combination of criteria over some other criterion or combination. For example, public participation, particularly direct citizen input, could reduce the delays involved in site selection and approval, but might also legitimize positions already held, either in support of or in opposition to the sites being considered. And, while public participation alternatives are also highly equitable strategies for distributing the costs, risks, and benefits of siting decisions, they often prove difficult to administer, due to bureaucratic resistance and inertia, public apathy, and changing situations.

E. Evaluation of Providing Participation Process Support

Process support for citizen involvement is difficult to assess as a separate category of alternatives for reducing the costs, risks, and delays involved in the siting of energy facilities because technical or financial assistance for participants is intended to be used in conjunction with other policy alternatives. For example, technical or financial assistance alternatives, implemented by awarding attorneys' fees, expert witness fees, or other costs of participation, are designed to be used with other information exchange, administrative interaction, or direct public input options. Thus, citizens' groups desiring access to the siting process through the avenue of public hearings could be provided with intervenor funding or technical staffing.[1] The nature of participation process support, therefore, is that it may serve to make other alternatives more effective, efficient, equitable, flexible, and implementable, depending on the circumstances in which they are used. For instance, process support will tend to be more equitable when applied to information exchange activities, more flexible and implementable when used in conjunction with interaction mechanisms, and more effective and efficient when applied to decisionmaking input options.

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[1] See Davis, Thomas P. "Citizen's Guide to Intervention in Nuclear Power Plant Siting: A Blueprint for Alice in Nuclear Wonderland." Environmental Law, Vol. 6 (Spring 1976), pp. 621-74.

However, some effects can be identified as a direct consequence of the application of process support. For example, providing technical expertise to participants may not be a very efficient or effective conflict resolution mechanism in the siting of energy facilities. Case studies of siting debates have shown that injecting technical expertise into the process often is an incentive for greater citizen involvement, but that it may also serve to legitimize, on technical grounds, positions already held. But these same studies have demonstrated that technical expertise is an extremely equitable alternative. That is, "equal access to knowledge, and the resulting ability to question data used to legitimize decisions, may at least permit political forces to operate on a more equitable basis."[1]

The barriers to implementing process support strategies are also well known: the issue of direct financial aid to participants particularly threatens established government rules and routines. Despite widespread acceptance of the principle of citizen involvement, recognition of the substantial costs of participation has resulted in Congress not outlining any federal position on the subject. Thus, the issue of financial aid has been left to the discretion of the regulatory agencies. Caught in a web of legal and procedural conflicts regarding the authority or desirability of using appropriations to fund participation and the problem of determining which interests require financial support, agencies have responded in widely varying fashions. The most determined opposition to financial aid has come from those agencies with highly complex and technological missions, such as the Nuclear Regulatory Commission (NRC) and the FPC.[2] Both these bodies have refused to fund intervenors in adjudicatory or rule-making procedures. Thus, while Congressional debates continue on proposals for a more comprehensive and liberal federal policy of reimbursement, significant resistance remains to the provision of financial assistance to citizens' groups in the siting of energy facilities.

Fortunately, there are other participation process support implementation strategies more flexible than financial support. Many agencies have acted to provide "facilitative assistance" short of actual institutionalized financial aid. These measures include: liberalizing the criteria for public admission to proceedings, relaxing some financial and procedural standards, providing access to internal data, and supplying technical staff assistance or information services. Other agencies have implemented "in house" public counsel offices, or offices of citizen advocacy.[1] Taken together, these alternatives provide a good foundation for increasing public representation in siting decisions.

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[1] Nelkin, Dorothy. "The Role of Experts in a Nuclear Siting Controversy." Bulletin of the Atomic Scientists, Vol. 30 (November 1974), p. 36. See also Gerlach, Luther P. "The Great Energy Standoff." Natural History, Vol. 87 (January 1978), pp. 22-37.

[2] Paglin, Max D., and Edgar Shor. "Regulatory Agency Response to the Development of Public Participation." Public Administration Review, Vol. 37 (March/April 1977), p. 147.

12.3.4 Summary and Comparison of Alternatives

The assessment of the four categories of alternatives leads to some general conclusions and comparisons regarding future energy facility siting policy, as indicated by Table 12-17. Significantly, no category of alternatives appears to be particularly effective in increasing the number of acceptable sites for new energy facilities. Technology-site evaluation holds perhaps the greatest potential for more clearly identifying those locations which will not generate unacceptable costs, risks, and delays, but a comprehensive evaluation approach could just as easily eliminate or block all or most energy development sites. Impact assistance and public participation options (with or without participation process support) seem likely merely to buttress existing values and attitudes in support of or in opposition to siting options. In part, the relatively low effectiveness of measures such as compensation or participation may be traced to the fact that public acceptance of energy facilities does not appear to hinge on the rational presentation of persuasive technical or economic arguments. Thus, implementation strategies designed to provide greater citizen involvement or to determine the correct "price" of facilities to the parties-at-interest may falter in the face of "irrational" public resistance based on psychological and sociopolitical factors (such as how development will affect the distribution of political power) quite apart from notions of technological risk or economic cost.[2]

The efficiency of the siting alternatives is also low. Once again, however, technology-site evaluation provides perhaps the best available alternative. Although methods such as site screening would eliminate some "least cost" options, technology-site evaluation appears to have the best ratio of benefits to costs. Each of the other categories suffers from major implementation

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[1] Paglin, Max D., and Edgar Shor. "Regulatory Agency Response to the Development of Public Participation." Public Administration Review, Vol. 37 (March/April 1977), p. 146-47.

[2] See Otway, Harry J., Dagmar Maurer, and Kerry Thomas. "Nuclear Power: The Question of Public Acceptance." Futures, Vol. 10 (April 1978), pp. 109-18; and Melbar, Barbara D., *et al*. Nuclear Power and the Public: Analysis of Collected Survey Research. Seattle, Wash.: Battelle Memorial Institute, 1977.

TABLE 12-17: SUMMARY AND COMPARISON OF ENERGY FACILITY SITING ALTERNATIVES[a]

CRITERIA	TECHNOLOGY-SITE EVALUATION	IMPACT ASSISTANCE METHODS	CITIZEN INVOLVEMENT IN SITING DECISIONS
Effectiveness	Technology-site evaluations could eliminate many sites Information gaps and federal-state implementation conflicts would impede expeditious siting of facilities	Impact assistance will reduce opposition to some sites Impact assistance will expedite the siting process if provided with sufficient lead time to facilitate state/local planning	Public participation can reduce delays involved in site selection and approval and thus lower development costs
Efficiency	Elimination of some "least-cost" locations would increase development costs Elimination of controversial sites would reduce risks of public opposition	High administrative costs will increase costs of energy development Impact assistance would reduce risks/uncertainties associated with citizen resistance and litigation	Public participation is moderately efficient. Administrative costs are low, but information exchange and litigation can be expensive
Equity	Technology-site evaluations distribute costs and risks, but do not facilitate an accurate determination of "winners" and "losers" in siting decisions	Impact assistance is very equitable if targeted specifically to areas with heavy impacts and provided sufficiently in advance of impacts	Public participation options can equalize the risks of development very well, particularly if used in conjunction with participation process support alternatives
Flexibility	Technology-site evaluation requires frequent modification and updating which is expensive in terms of time and money	Impact assistance is not very adaptable to changing circumstances Various assistance mechanisms can be substituted inexpensively	Public participation alternatives are highly flexible and range from information exchange through administrative interaction to direct citizen input
Implementability	Technology-site evaluation is likely to arouse state/local opposition if siting decisions are at variance with the values of affected groups	Impact assistance may attract "free riders" and opportunists and does little to reduce resistance of outside interests to energy development	Public participation alternatives are widely accepted by agencies and interest groups, but often prove difficult to administer

[a] The participation process support alternative is not included in this table because it is normally used in conjunction with public participation alternatives.

costs: impact assistance and participation process support measures have high administrative costs, and citizen involvement mechanisms require large data and organizational expenses. These pessimistic efficiency conclusions are based to some extent on an assumption that while substantial gains can certainly be made in improving the predictability and certainty of the siting process, there is no quick legislative or administrative "fix" for the current energy facility siting dilemma. Arriving at an acceptable technology-location combination while ensuring the representation of all legitimately affected interests is almost always likely to be an inefficient process in our pluralistic society.[1]

If efficiency and effectiveness are the weaknesses of the alternatives discussed for siting energy facilities, then equity is their strength. Impact assistance is easily the best method for distributing the costs of energy development and public participation (especially if used with participation process support) offers an equitable means of distributing the risks of siting energy facilities. Technology-site evaluation is the least equitable alternative, but even this option could significantly reduce the risks of development by establishing a threshold above which no locality would have to bear the impacts of energy production. Each of these alternatives thus contributes to the requirements of an equitable decisionmaking system, in which "management must be willing to enter into a meaningful dialogue with both regional and local citizen groups (not just economically interested groups, of course) and share with them the information gathering and evaluating programs, the goal-formulating, the planning, the establishment of priorities, and the actual implementation of policies."[2]

Public participation options are the most flexible alternatives for facilitating the timely location of energy projects. A strategy of participation may have at least five different orientations: (1) as an overarching objective of democractic politics, to produce "better" decisions; (2) to alter power relationships or to legitimize decisions; (3) to improve communications among parties-at-interest; (4) to reduce conflicts, tensions, and misperceptions among participants; and (5) to reduce citizen alienation as a form of "social therapy."[1] None of the other categories of alternatives considered can approach this adaptability and adjustability: technology-site evaluation and impact assistance are relatively narrowly defined and highly structured options for siting energy facilities.

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[1] See Irland, Lloyd C. "Citizen Participation--A Tool for Conflict Management on the Public Lands." Public Administration Review, Vol. 35 (May/June 1975), p. 265.

[2] Wengert, Norman. "Citizen Participation: Practice in Search of a Theory." Natural Resources Journal, Vol. 16 (January 1976), pp. 23-40. See also Hart, David K. "Theories of Government Related to Decentralization and Citizen Participation." Public Administration Review, Vol. 32 (October 1972), pp. 603-21.

Finally, public participation also appears to be the most implementable category of siting alternatives. Although there is resistance within the bureaucracy to the actual sharing of power by citizens' groups (i.e., citizen review boards), the momentum for public involvement is now well developed. No such degree of acceptability exists for technology-site evaluation, participation process support, or impact assistance, which still suffer from perceptions that most impacts are not measurable, that "you can't measure everything in money" or that some costs are simply uncompensable.[2]

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[1] Frauenglass, Harvey. "Environmental Policy: Public Participation and the Open Information System." Natural Resources Journal, Vol. 11 (July 1971), pp. 495-96.

[2] O'Hare, Michael. "'Not on My Block You Don't': Facility Siting and the Strategic Importance of Compensation." Public Policy, Vol. 25 (Fall 1977), pp. 454-55.

CHAPTER 13

SUMMARY AND OVERVIEW

13.1 INTRODUCTION

Each of the preceding nine chapters focused on a separate category of problems and issues. While these nine categories are not exhaustive, they include what we have found to be among the most significant problems and issues likely to result from western energy resource development.

The purpose of this chapter is to provide a different perspective of what we have learned from these analyses. Following a brief description of several characteristics of the policymaking system, we will summarize our findings by suggesting alternatives that Indian tribes, energy developers, and policymakers at each level of government can consider in order to achieve desired benefits of western energy resource development while minimizing costs and risks.

13.2 KEY CHARACTERISTICS OF THE POLICYMAKING SYSTEM

A general overview of the social and political context of western energy resource development was presented in Chapters 1 and 2. Rather than repeat that description, this section focuses on several key characteristics of the U.S. political system which significantly affect policymaking for dealing with the consequences of western energy development. The first of these characteristics is that policy is most often made in substantive problem and issue categories such as those used to organize our policy analyses in Chapters 4-12. Thus, "western energy resource development" is not a central category for organizing policymaking. For example, although energy development may be taken into account when air and water quality policies are made and implemented, policy is made in terms of substantive categories themselves. As a consequence, policy which affects the development of energy resources in the western U.S. is fragmented, consisting of several responses which address specific problems.

The second key characteristic of the political system is that policies are made and implemented by various levels, branches, and agencies of government and by a range of private sector participants. In this system, questions are constantly being raised about whether problems and issues should be considered public or private and about the appropriate roles of the two. This is certainly the case in energy policymaking because, until recently, energy was a substantive policy area in which, with few exceptions, government played a relatively minor role and assumed only limited responsibilities. And it is also the case with regard to western energy resource development, where old roles, relationships, and responsibilities have been upset, and new ones are being worked out.

Although the system is currently unstable, it is clear that many of the decisions which will largely determine the consequences of western energy resource development such as the location and type of development, are still and will probably continue to be private sector decisions. Given present policies and existing public-private policymaking roles and responsibilities, the private sector will largely decide such things as whether to "strip and ship" coal or convert it at or near the mine-mouth; whether to convert coal to electricity or synfuels; whether to minimize water consumption; and whether and when to go to commercial-scale oil shale development.

Private sector decisions are, of course, affected by siting laws, leasing and land-use policies, air and water quality regulations, tax and pricing policies, certifications for public convenience and necessity, and other government policy and programs. But, just as there is [illegible] unified western energy resource development policy, there is [illegible] unified system for making and implementing public policies that affect development. Not only are multiple levels of government involved, but at each level the executive, legislative, and judicial branches have a role. Within the executive, more than one agency has administrative, rule-making, and/or regulatory responsibilities; and roles and responsibilities among agencies are often conflicting.

For these reasons, it is difficult to address western energy resource development comprehensively. Energy developers--such as utilities, mining and energy companies--will retain the major initiative by seeking approval for separate developments. To the extent that government attempts to shape the consequences of western energy resource development, it is likely to do so primarily by regulating facility siting, air and water quality, surface mine reclamation, transportation modes, and other specific problems.

Two additional characteristics should be kept in mind in this discussion of what policymakers can do to shape the consequences of development. First, policymakers at various levels and in different branches and agencies, in Indian tribes, and in the private sector have different objectives and rank the interests and values at stake differently. Second, the results of our analyses indicate that the most direct way to attempt to control consequences is to control the combinations of technologies and locations which are allowed.[1] This suggests that facility siting and comprehensive land-use planning and management are possible approaches for attempting to control the consequences of development directly. Although the existing policy system is not particularly hospitable to either, public and tribal ownership of large land areas (including mineral rights) and control of water rights make comprehensive control a potentially feasible alternative.

13.3 CONTROLLING THE CONSEQUENCES OF WESTERN ENERGY RESOURCE DEVELOPMENT

13.3.1 Introduction

Our impact and policy analysis results confirm the conventional wisdom that developing western energy resources will produce a variety of environmental and socioeconomic costs and risks along with the energy and socioeconomic benefits which motivate their development. Chapters 4-12 summarize the major consequences of development in nine separate problem and issue categories, and indicate how alternative policies and implementation strategies will distribute costs, risks, and benefits. This chapter will focus on issues and policy responses available to different groups of policymakers. For each group, we will briefly summarize the major development consequences likely to be experienced and indicate the responses which policymakers might take to deal with these consequences.

The discussion will be organized around five groups: local governments; state governments; Indians; the federal government; and energy developers. These groups do not include all of the participants in the policymaking system. However, they do include the categories of policymakers who will have primary responsibility for dealing with the problems and issues associated with western energy resource development. Within each of these categories, more specific groups will be discussed; for example, "local" policymakers include elected municipal and county officials, and representatives of multicounty organizations. By organizing the discussion in this way, we do not imply that policymakers at each of these levels act independently of each other. As noted in Chapter 2 and as shown throughout this policy report, our system of government is characterized by shared, overlapping, and often ambiguous roles and responsibilities. These interactions will be noted in the following discussion, and particular attention will be paid to issue areas where more intergovernmental and public-private sector cooperation appears to be needed if problems are to be dealt with adequately.

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[1] Briefly, the same technology can produce significantly different impacts when it is sited at locations with different characteristics. In our impact analyses, we attempted to identify the most significant technological and locational factors affecting impacts. See: White, Irvin L., et al. Energy From the West: A Progress Report of a Technology Assessment of Western Energy Resource Development. Washington, D.C.: U.S., Environmental Protection Agency, 1977; and White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming. See also Chapters 3 and 12 of this report.

13.3.2 Local Governments

Virtually all of the consequences of western energy resource development create issues of concern to local governments. However, local officials have very little to say regarding when, where, and how development occurs; moreover, they lack the resources and authority to control most of these consequences, and, therefore, are usually dependent on other levels of government and energy developers for assistance. For example, the federal and state governments generally regulate the impacts on air, land, and water resources; and decisions by energy developers largely determine population-related costs and benefits.

Local governments are creatures of the states; their taxing, zoning, public health and safety and other powers are defined by the states. Although they may use their planning and zoning powers in ways which to some extent affect the physical and environmental consequences of development, local governments, particularly municipalities, can do very little to impose direct environmental controls on energy development. In response to such problems as air and water quality impacts and surface land disturbances, local governments are largely limited to attempting to influence state and federal policies and programs. The same point can be made for socioeconomic consequences, which are often the most immediate and significant problems confronting local governments when energy development occurs nearby. Even though they lack adequate resources and authority to control these consequences, local governments are expected to create an environment favorable to economic growth and provide residents an opportunity to achieve the quality of life they desire.

A. Impacts and Issues of Concern to Local Governments

The consequences for local policymakers of energy development and its related growth have been elaborated in Chapters 8 (Housing) and 9 (Growth Management), and to a lesser extent in Chapter 5 (Water Quality), Chapter 7 (Land Use and Reclamation), and Chapter 11 (Transportation). The basic dilemma facing local policymakers is how to balance the potential economic benefits of energy-related growth and the limited capability to respond adequately to the demands of rapid and large population increases.

(1) Economic Benefits

Energy development will generate important social and economic advantages for nearby localities, including expanded employment opportunities, higher salaries, and the more indirect benefits of expanded retail trade and increased social and cultural opportunities. In fact, throughout the eight-state study area, both residents and local officials appear to be among the most enthusiastic supporters of energy development.[1]

The importance of the economic opportunities offered by energy development is suggested by the data in Table 13-1 which show median household incomes for the 10 counties studied in our impact analysis. In all but one case, Campbell County, Wyoming, household incomes for the counties were lower than the national median--ranging from 10 percent lower (San Juan County, New Mexico) to 31 percent lower (Rosebud County, Montana, and Mercer County, North Dakota). The high household income for Campbell County, Wyoming, can be attributed to the oil and gas boom in that area during the 1960's.

It is difficult to predict the impact of western energy development on personal incomes since economic benefits will depend on the rate, scale, and location of energy facilities. However, to illustrate the relative magnitude of effects, we estimated statewide changes in personal income by the year 2000 based on a Low Demand energy development scenario.[2] Based on this scenario, total incomes per household would range from about $14,000 in New Mexico to about $20,000 in North Dakota (1975 dollars).[3] When these figures and those in Table 13-1 are compared and inflation between 1969 and 1975 is taken into account, increases in income in the area are estimated to be quite large. Obviously, these statewide estimates do not imply that every household in energy-impacted areas could anticipate such a dramatic change. In fact, economic benefits would be greater during the short term

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[1] This conclusion is not based on a comparative scientific analysis of opinions in these areas--which to our knowledge is not currently available. It reflects our experience from visits and intensive discussions with officials and residents of each of these areas.

[2] The Low Demand scenario calls for a national production of 124 Q, of which 42.6 is produced in the eight-state study area. For a brief description of this scenario see Chapter 2 of this report, and for a detailed description see White, Irvin L., _et al._ _Energy From the West: Impact Analysis Report_. Washington, _D.C._: U.S., Environmental Protection Agency, forthcoming, Chapter 11.

[3] These projections assume household incomes will be at least three times per capita incomes. See _Ibid_., Chapter 11.4.3.

TABLE 13-1: MEDIAN HOUSEHOLD INCOMES IN TEN ENERGY-IMPACTED COUNTIES (1969 dollars)

LOCATION	MEDIAN INCOME	PERCENT DIFFERENCE FROM NATIONAL AVERAGE
National	$ 8,448	-
Colorado	8,398	
Garfield County	7,430	-12
Rio Blanco County	7,195	-15
Montana	7,324	
Rosebud County	5,855	-31
New Mexico	7,015	
San Juan County	7,572	-10
North Dakota	6,888	
Mercer County	5,795	-31
McClean County	6,039	-29
Oliver County	6,049	-28
Utah	8,447	
Kane County	6,234	-26
Garfield County	6,099	-16
Wyoming	7,934	
Campbell County	10,836	+28

Source: U.S., Department of Commerce, Bureau of the Census. Census of Population: Household Income in 1969 for States, SMSA's, Cities, and Counties. Washington, D.C.: Government Printing Office, 1976.

(construction) than over the long term (operation) of a facility; and many residents will only be affected by indirect rather than direct economic benefits. However, the point is that energy development on this scale will certainly provide economic stimulus to the area and give many residents a chance to increase their incomes substantially.

(2) Growth Management Problems

The potential economic benefits of energy development must be contrasted with serious growth management problems that local officials will face. As elaborated in Chapter 9 of this report, municipal services and facilities quickly become inadequate for current residents as well as for those who move into the area because of energy-related job opportunities. To meet the needs of larger populations, new facilities will have to be constructed to provide public services such as water supply, sewage treatment, detention facilities, and medical care. The costs of needed public facilities are high--capital costs ranging from $750,000 to $1.15 million and operating costs of $65,000 per year for every 500 new residents.[1]

The fundamental problem is that municipalities have few financial or planning resources. Therefore, they must depend heavily on other units of government and energy resource developers. While county governments and school districts face similar problems, they are generally fewer and less severe, and both will have larger tax revenues with which to respond.

The financial problems faced by local governments involve the distribution of tax revenues among jurisdictions and the timing of revenue receipts to coincide with need. To illustrate, Figure 13-1 shows revenue projections for the 1980-2000 period for our Low Demand energy development scenario in Campbell County, Wyoming. These data show a typical pattern for energy developments; while city and county revenues are initially approximately equal, county revenues begin to increase very soon after development is initiated whereas city revenues increase much more gradually. This is because the facilities are usually located within county, not municipal boundaries. Thus, while revenues are needed prior to or once development begins, revenues are not generally available to municipalities until the energy facility is operable. By the year 2000, county and school revenues not only reach much higher absolute levels than do municipal revenues, they also increase twice as fast as do city revenues.

In addition to these revenue growth problems, local financial difficulties are intensified in each of the eight western states included in this study by state ceilings on bonded debt. These ceilings limit the capacity of towns, counties, and school districts to finance and construct public facilities prior to the influx of large numbers of new residents.

Municipalities' financial problems are also magnified by planning inadequacies. A professional planning capability is nonexistent in most of the western towns likely to be impacted by energy resource development. This is largely because these towns are typically very small (under 5,000 people); however, traditional antagonism to planning and land-use control, and the lack of information concerning scheduling and magnitude of energy development

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[1] These cost estimates include fire protection, law enforcement, water, sewage treatment, garbage service, health care, jails, juvenile treatment and custody facilities, county and municipal courts, recreation facilities and administrative space. They are based on capital costs of $1,500 to $2,300 per capita and operating costs of $130 per year per capita. See Chapter 9, Section 2 for details.

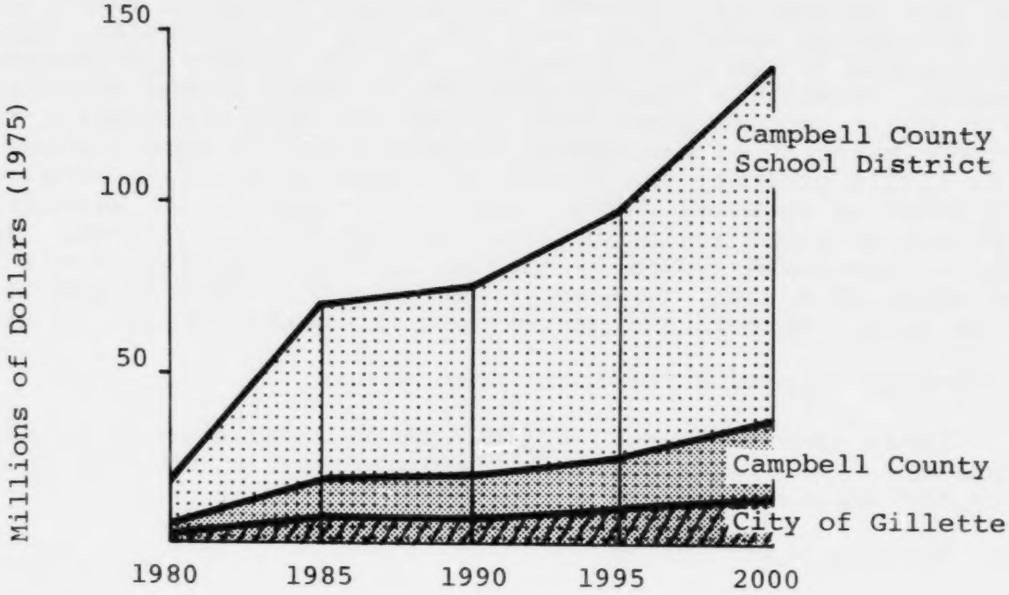

FIGURE 13-1: PROJECTED REVENUE IMBALANCES IN CAMPBELL COUNTY, WYOMING, 2000[a]

[a] These projections are for a hypothetical energy development scenario in Campbell County, Wyoming. They are not intended as a prediction of actual trends. For a detailed description and analysis of this scenario and its implications see White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming, Chapter 7.

contribute to local inability to anticipate and plan for rapid growth.

(3) Housing Inadequacies

Another problem faced by communities in the vicinity of energy developments is the inadequate quantity and quality of housing (see Chapter 8). Housing is typically in short supply primarily because of uncertainty over long-term housing needs, financing constraints in the private market, and the absence of governmental programs to address housing problems in rapid growth situations. As a result, mobile homes have become the dominant housing type for the majority of newcomers. However, mobile homes, which provide little property tax benefit to local governments because they are taxed as personal rather than real property, are usually restricted by local zoning to less desirable areas of town. Hence, mobile home parks typically cluster in unincorporated areas on the edges of a town, typically receive a low level of public services (e.g., streets and parks), and are generally low in quality.

B. Policy Responses for Local Governments

Table 13-2 lists some policy options available to local policymakers. As suggested by the table, local initiatives to deal with the impacts and issues identified are few.

(1) Revenue Distribution

One option available to municipalities for dealing with revenue distribution problems is to annex county land in order to include an energy facility in the town's tax base. This alternative would increase municipal revenues and extend zoning and planning powers to development sites. Although this annexation alternative has not yet been used in the West, Wyoming's Joint Powers Act, permitting cities and counties to act jointly in providing public services and facilities, is closely related. However, the act requires county governments to cooperate as well as give their consent. Counties tend to be unwilling to add to their responsibilities. Also, city-county cooperation does not adequately address demands for services and facilities before new energy facilities begin paying taxes.

Alternatives for providing front-end assistance include redistribution of state severance taxes and prepayment of property taxes by energy facilities. However, local governments depend on state or federal action for either alternative to be available.

Closely linked to financial problems are problems of planning. Generally, local governments and planning authorities will require outside assistance to plan for energy development. The need for more accurate and timely information could be addressed at the state level by facility siting legislation, requiring better

TABLE 13-2: POLICY ALTERNATIVES AT THE LOCAL LEVEL

CATEGORY OF RESPONSE	ALTERNATIVE	CHAPTER REFERENCE
Revenue distribution	Municipal annexation of county land	Ch. 9.3
Improve mobile home situation	Develop quality mobile home parks	Ch. 8.3
	Institute local land-use controls for all areas of a county	Ch. 8.3

reporting of development plans or reducing some of the uncertainties associated with the siting process. At the national level, policies such as the Energy Impact Assistance Act of 1978[1] (considered but not passed by the 95th Congress) are designed to provide both better information about development and technical assistance to use such information.

(2) Improve Mobile Home Parks

Local governments have virtually no control over housing availability problems. However, they can attempt to improve housing quality by improving the mobile home situation. Encouraging better quality mobile home parks and county-wide land-use controls could reduce densities and help to provide more amenities, such as paved streets and neighborhood parks. Since these services will require additional public expenditures, classifying mobile homes as real rather than personal property could increase the property tax revenues to help pay for this service. Again, state governments would have to enact legislation authorizing this change.

The overall picture which emerges from this discussion is that municipal governments, facing immediate and potentially severe growth management problems, have virtually no independent capability to respond. And, to a large degree, institutional mechanisms for ensuring that the particular needs of energy boomtowns are met, either from other levels of government or from the private sector, do not exist.

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[1] The 1978 Act was an amended version of Senate Bill 1493, Inland Energy Development Impact Assistance Act of 1977, introduced in May 1977 by Colorado Senator Gary Hart. This act was cosponsored by Hart and Senator Jennings Randolph of West Virginia.

13.3.3 State Governments

Western states are in a pivotal position in dealing with consequences of energy development. Although statewide impacts generally will be smaller and occur later than in the local areas close to energy developments, each of the nine issue categories discussed in Chapters 4-12 will affect state governments. A state obviously does not exert complete control in any single issue area; for example, control over water resources is influenced by actions of other states, Indians, and the federal government, and environmental protection is an area where the federal government has a major role. Nevertheless, in contrast to local governments, state governments have considerable control over the problems they face, either through their own laws and regulations or through cooperative arrangements with other governmental units or the private sector.

A. Impacts and Issues of Concern to State Governments

The issues and impacts of primary concern to the states can be considered in four categories: economic benefits; growth management assistance; water availability; and environmental protection.

(1) Economic Benefits

States can anticipate substantial economic advantages from energy resource development. The most important economic benefit for state governments will be increases in state revenues from both direct taxes on energy development and increased income tax revenues. To give an idea of the magnitude of such effects, we projected state revenues from direct energy-related taxes (mineral severance taxes, property taxes, and energy conversion taxes) for our Low Demand scenario, using current tax levels in each state. The results for six states in the year 2000 are shown in Figure 13-2. Nearly 3 billion dollars in new revenue per year (1975 dollars) is projected for six states by the year 2000.[1] About 45 percent of this revenue would be generated in Montana, because of that state's high severance tax and the assumption of large amounts of coal development for Montana in our Low Demand scenario. Montana's direct energy tax revenue would be about $1.3 billion by the year 2000, representing about a 450 percent increase over its 1975 direct energy tax revenues.

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[1] These estimates, based on our Low Demand scenario, depend largely upon the number of conversion facilities and the tax rates for each state. In practice, if large surpluses were generated, tax rates would probably be lowered. See White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming, Chapter 11.4.

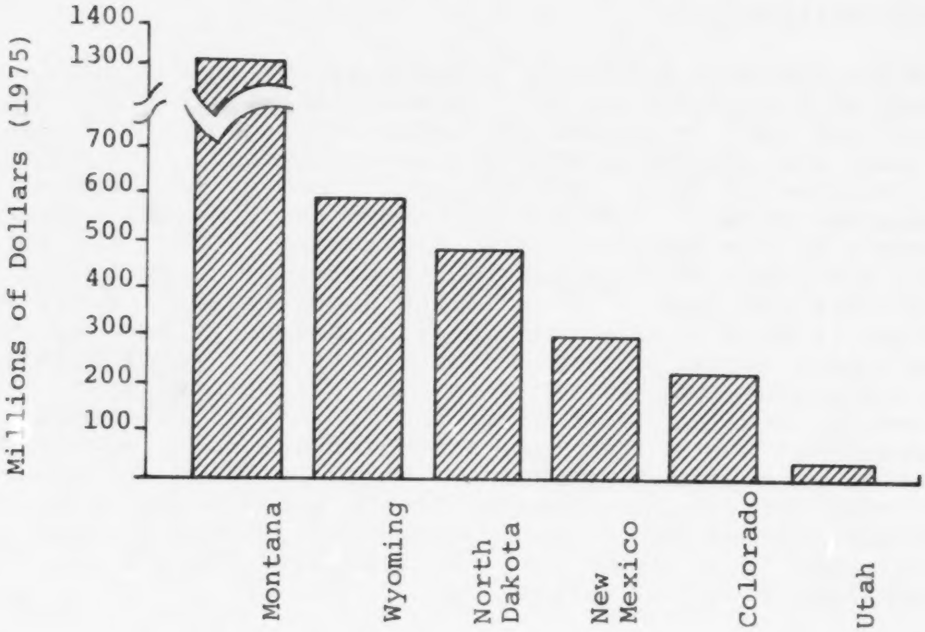

FIGURE 13-2: ANNUAL ENERGY TAX AND PROPERTY TAX REVENUES, YEAR 2000

(2) Growth Management Assistance

At the state level, population growth due directly to energy development is not estimated to be great; no more than 200,000 permanent new residents are projected for any one state in our Low Demand scenario.[1] Perhaps more importantly, the estimated permanent population increases would occur gradually over the next 20 to 25 years so that growth impacts at the state level would be manageable. However, local governments can be expected to demand state assistance in dealing with growth related problems since, as discussed above, few local areas will be able, by themselves, to deal effectively with planning, housing, revenue distribution, and front-end financing problems.

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[1] See White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming, Chapter 11.4.2.

(3) Water Availability

Perhaps the most difficult problem states in our eight-state study area will confront is water availability. This is largely because of the real potential for water shortages, both basin-wide and for many specific streams and stream segments. For example, when projections of water consumption for energy development based on our Nominal Demand[1] scenario are added to projected nonenergy requirements in the Upper Colorado River Basin (UCRB) for the year 2000, the total may exceed existing supplies by as much as 1 million acre-feet per year.[2] Even in the Upper Missouri River Basin where water is more abundant basin-wide, energy related water requirements have already increased conflicts over water rights in specific locations, particularly in the Yellowstone River. In many respects, resolution of water conflicts will determine the future growth of western states, including the rate, magnitude, and location of energy development. Water problems and issues are made even more serious because of the uncertainty associated with new national water policies, increased conflicts among states of the Colorado River Basin, and the potential control of large water supplies by Indian tribes.

(4) Environmental Quality

States will face numerous environmental quality issues as a result of energy resource development. Anticipated environmental threats include:

- Reduced air quality, including reduced visibility;
- Ecological effects of reduced stream flows;
- Potential for water pollution, both surface and underground;
- Land impacts from surface mining and waste disposal;
- Disruption of groundwater flows;
- Aesthetic impacts of surface mining and other facilities;
- Noise and safety effects of unit trains.

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[1] The Nominal Demand scenario calls for a national production of 155.1 Q, of which 60.7 is produced in the eight-state study area. For a brief description of this scenario see Chapter 2 of this report, and for a detailed discussion, see White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming, Chapter 11.

[2] See Chapter 4.2.1.

B. Policy Responses for State Governments

States are usually in the position of reacting to the energy development initiatives of private sector developers, the federal government, or Indian tribes. This is particularly true in the West since so much western land is owned by the federal government and Indians.[1] Within these limits, states exercise considerable control over the level of energy development and impacts. Table 13-3 summarizes policy responses available to the states. As listed in the table and as suggested previously in the local government section, states have primary responsibility for providing assistance to local communities impacted by energy development. In this problem area, states generally possess the authority and the financial means for effectively responding to growth management problems independent of the federal government.

A second state response category balances energy development with other demands on the state's resources, particularly environmental protection and the use of water. In this respect, states have considerable responsibility, authority, and flexibility in policy responses. Yet, their actions are usually constrained by federal guidelines and requirements; and states often need to cooperate with or seek assistance from the federal government, other states, and energy developers.

A third related category of responses concerns the state role in the siting of new energy facilities. A state's siting policies affect not only the extent of social, economic, and environmental impacts, but also the time and cost energy developers must invest in expanding energy production capacity. Some policy responses available to state governments in each of these three categories are discussed below.

(1) Community Impact Assistance

States appear to be the most appropriate level of government for dealing with population-related impacts and appear to have at their disposal several potentially effective responses. However, with one or two exceptions states have been slow to develop institutional mechanisms for dealing with these problems, even though several localities in the eight states included in this study already have or are beginning to experience severe growth management problems. The various policy alternatives available to the states are of two types: modifying state tax laws and requiring developers to provide impact assistance.

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[1] Approximately 35 percent of the eight-state area is owned by the federal government and 9 percent by Indian tribes. About 65 percent of Utah is federally owned.

TABLE 13-3: POLICY RESPONSES BY STATE GOVERNMENTS

CATEGORY OF RESPONSE	STATE POLICY ALTERNATIVES	CHAPTER REFERENCE
Community Impact Assistance	Modify state tax laws to improve financial capacities	Ch. 8.3, 9.3, and 12.3
	Require industry impact assistance	Ch. 8.3, 9.3, and 12.3
Water Use and Environmental Controls	Improve water use management system	Ch. 4.3
	Strengthen state environmental programs	Ch. 5.3, 7.3 and 11.3
	Increase regulatory flexibility and planning	Ch. 5.3, 6.3, and 7.3
Siting	Undertake technology-site evaluations	Ch. 12.3, 6.3, and 7.3
	Increase citizen involvement in siting	Ch. 12.3

(a) Modify State Tax Laws

Local government growth management problems are largely a consequence of tax revenue distribution inequities (e.g., between counties and municipalities) and insufficient front-end money. As discussed in Chapter 9, states could make a variety of changes in state law which could help alleviate these problems. For example, to deal with the problem of inequitable distribution of property taxes among local jurisdictions, states could collect property taxes on energy facilities and then distribute the revenue to impacted communities. Although there is some precedent for this approach, for example, Wisconsin has adopted a plan similar in concept, it would probably be difficult to implement because it would be a basic change in long-established taxation policies.

Another alternative is for states to develop programs for distributing a portion of severance tax revenues to the impacted communities. In Montana, a 30 percent severance tax on coal has provided considerable revenues to impacted communities--and has increased general revenue funds. However, Montana's tax has raised questions about appropriate severance tax levels, particularly questions of interregional equity.

Equitable distribution of the tax also requires that impacted communities and the nature of the impacts be accurately identified. Given the inadequacy of the financial and planning capabilities of most energy-impacted western towns, many impacted areas may have difficulty documenting their needs. That this is the case emphasizes the extent to which local and state governments are dependent on energy developers for accurate information about the timing and nature of development.

Other tax policy alternatives available to the states include classifying mobile homes as real property for taxation, allowing energy companies to claim the value of assistance provided as a tax deduction, and requiring the prepayment of property taxes so as to make these revenues available at the front end when they are most needed (see Chapters 8 and 9). The requirement for prepayment of property taxes could be made less objectionable to industry with changes in Internal Revenue Service regulations to allow full deductions for the years in which taxes were prepaid.

(b) Require Industry Impact Assistance

Another type of state response for dealing with social and economic impacts is to make siting permits conditional on the developer undertaking certain impact mitigation actions. For example, one condition could be to require developers to provide timely information on planned development. At a minimum, such legislation would require developers to report information on construction and operating work force, land use, and likely environmental impacts directly to local governments. The state could also require developers to ensure that adequate housing is available for the expected work force. Requiring developers to provide impact assistance is especially attractive because of its flexibility; that is, specific measures can be tailored to meet the degree of impacts of a particular technology at a particular site.

Although such siting requirements are not yet common in the West, the Wyoming Industrial Development Information and Siting Act of 1975[1] is an example of this type of policy alternative. The Wyoming Industrial Siting Authority conditions the approval of siting permits for major energy and industrial facilities on the mitigation of socioeconomic impacts. A well-known result of this stipulation is the case in which Basin Electric Power Cooperative agreed to provide 1,900 homes, together with other impact assistance, in return for permission to build a plant near Wheatland, Wyoming (see Chapter 8).

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[1] Wyoming Industrial Development Information and Siting Act, Wyoming Statutes, §§ 35-502.75 through 35-502.94.

(2) Water Use and Environmental Controls

States have direct control over allocation of state-owned water resources. However, in exercising this control they are constrained by the long and complex history of water resource management, particularly the appropriation system, interstate arrangements, and federal water projects. Water supply augmentation options, such as impoundments, diversions, and transfers, are primarily a federal responsibility because of their costs and interstate implications; however, recent proposals by the Carter Administration would increase somewhat the state role in water supply projects by requiring state cost-sharing.

On environmental issues, the states are much more dependent on the federal government, since federal regulations establish strict and uniform standards in several areas, including: reclamation requirements; minimum air quality standards, Prevention of Significant Deterioration (PSD) Standards, and air pollution emission limits; water quality and water discharge standards for municipal and industrial users; and regulations regarding the disposal of solid wastes. Nevertheless, states still have considerable power in environmental matters, including the authority to impose stricter regulations and to establish regulations for problems either not covered or not covered adequately by federal laws. Three policy approaches for states in this category are: improved management of the state's water resources, strengthened environmental programs, and increased regulatory flexibility and planning.

(a) Improve Water Use Management System

As indicated in Chapter 4, if states wish to provide adequate water for all competing uses, their most effective choices are to encourage water conservation in both energy resource development and in agriculture. States can discourage certain water-intensive energy conversion facilities, such as electric power plants, and encourage the use of water-saving cooling technologies. For example, as discussed in Chapter 4, the use of less water-consumptive cooling systems can reduce water requirements by approximately 70 percent for both Lurgi gasification and steam-electric power generation.

Alternatives for encouraging conservation in irrigated agriculture include improving irrigation efficiency by requiring mechanical irrigation systems, encouraging less water-intensive crops such as vegetables, improving water conveyance systems to reduce evaporation, and eliminating or controlling nonproductive vegetation which consumes large amounts of water. While the potential for agricultural water savings appears to be large, there is great uncertainty regarding total water savings; and substantial economic and other barriers would have to be overcome for these water-saving measures to be implemented. For example, mechanical irrigation will increase production costs about $60-$150 per acre, which appears prohibitive for many farmers. Also, the irrigator risks losing the rights to salvaged water.

Adopting these water conservation measures would mean changing existing institutions for making water decisions. Appropriation systems are particularly threatened, since they characteristically exert rigid controls over the use of water which act as disincentives for conservation. In fact, several western states have already made incremental changes in appropriation system in order to account for broader definitions of the "beneficial use" of water. However, more radical changes which allow for more comprehensive water resource management may be required to cope with the increasing probability that not all water users can be accommodated. Making these changes will almost certainly increase water-related conflicts in the region.

(b) Strengthen State Environmental Programs

Another area where states could take action is in developing stronger programs to control the environmental impacts of energy development not now adequately covered by existing state and federal laws and regulations. Several areas of need have been identified in previous chapters, including land rehabilitation for surface mining, disposal of wastes, and mitigation of impacts of increased unit train traffic.

State action on land rehabilitation is needed for two reasons. Most importantly, the recent federal strip mine reclamation law[1] covers only coal mining; and land reclamation laws in several western states do not apply or are inadequate with regard to resources other than coal (e.g., oil shale, uranium and geothermal). Second, both the federal and state regulations governing waste disposal may be inadequate for the western situation, especially in the cases of spent shale and uranium mill tailings. Strong state action in these areas now could preclude the need for federal action.

Another area where the states could take the lead is in reducing the adverse impacts of coal unit train traffic. One possible strategy, elaborated in Chapter 11, is for states to establish a task force consisting of representatives of the railroad companies and various levels of government. This task force would undertake planning studies and establish priorities for measures to mitigate existing or potential impacts. An example of this type of state action is the Colorado coal train assessment funded by the Four Corners Regional Commission (see Chapter 11). Since the task force approach could be implemented by the executive branch of state government no new legislation would be required. The main constraint would be providing sufficient funds to implement the recommendations of the task force. New state or federal funding programs would probably be required.

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[1] Surface Mining Control and Reclamation Act of 1977, Pub. L. 95-87, 91 Stat. 445.

Finally, it should be noted that the state water conservation policies discussed previously could, in addition to stretching existing supplies, substantially improve water quality, and help protect instream flow values. In this sense, therefore, water conservation options are also environmental protection measures. In fact, as discussed in Chapter 5, controlling agricultural sources appears to be one of the most effective water pollution control measures available.

(c) Increased Regulatory Flexibility and Planning

Although the federal government has assumed much of the authority for environmental protection policies, in most cases the states are responsible for implementation. For example, the federal government has set national ambient air quality standards, but the states are responsible for developing state implementation plans (SIP's) to achieve or maintain compliance with the standards. Since states can set standards stricter than the federal standards, they can use this flexibility to restrict energy development in order to protect environmental values. However, there are several policies which states could follow to give more flexibility in environmental regulations. These have been discussed in previous chapters, including those dealing with air quality, land rehabilitation, and water quality.

For example, as discussed in Chapter 6, states could reserve a portion of the PSD increment in some areas for energy facilities. The goal would be to ensure that energy development is not blocked, but that PSD standards are maintained. This approach could be implemented by the SIP; however, federal approval might be required.

Another alternative discussed in the air policy area concerns the siting of smaller, dispersed energy conversion facilities. By siting smaller facilities over a wide area, ground-level air pollution concentrations (and other environmental impacts in the vicinity of the plant) would be reduced, thus relaxing constraints on energy development due to air quality and other environmental standards. However, this alternative can produce other positive and negative effects. The mix will depend largely on many site-specific factors. Thus, rather than requiring that this policy be adopted, state utility commissions could at least require utilities to consider the smaller facilities alternative in their planning. New York State has taken this approach (see Chapter 6).

Water quality control offers another example of how states can improve the regulatory system within the federally established boundaries. States must meet federal salinity standards for the Colorado River. Until recently they depended almost totally on federal funds for meeting these standards. However, the states in the Colorado River Basin have established the Colorado Salinity Control Forum to develop mechanisms for meeting Environmental Protection Agency (EPA) standards. The Forum is the first attempt by states to address water quality problems through a coordinated decisionmaking process rather than by relying on traditional physical controls and construction projects. While the success of this body is still undetermined, it could be a useful model for state cooperation in other areas, such as water availability.

(3) Siting

A third category of state policy responses for dealing with the consequences of western energy development is siting. In this context siting refers to state laws either approving or influencing the decisions developers make concerning the type of technology and the location for new energy facilities. While all levels of government are involved in some way in the siting process, states exercise major controls on a day to day basis. Nevertheless, the federal government may play a strong role in establishing general siting guidelines and in encouraging certain actions on the part of the states, as discussed in the federal section of this chapter.

As indicated in Table 13-3 two types of siting policy responses can be considered: undertake technology-site evaluations and increase citizen participation in the siting process. However, it should be noted that because siting is such a comprehensive category, several of the other alternatives already discussed have to do with the siting process and thus could also be cross-listed in this category (e.g., requiring industry impact assistance and establishing energy parks). The primary objective of the siting policies is to avoid or reduce impacts from energy development, and also to minimize costly delays once major investments are made.

(a) Undertake Technology-Site Evaluations

As elaborated in Chapter 12, technology-site evaluations can include a range of specific strategies, including elimination of some sites from consideration, designation of appropriate sites, elimination of certain technologies at given sites, and determination of the size, environmental controls, and/or socioeconomic mitigation which would be required for particular technologies at a given site. All are based on the exclusion of some areas from energy development and represent an extension of zoning practices on a larger scale. North Dakota's Energy Conversion and Transmission Facility Siting Act[1] represents an example of designating certain unacceptable locations. Under the provisions of this law, energy facilities are excluded from state parks, areas where animal or plant species unique or rare to the state would be irreversibly damaged, prime farm land, and irrigated land. Other more flexible methods would rely on site screening to evaluate each technology-location configuration individually; for example, a power plant utilizing wet cooling may be screened out of a particular area although less water-consumptive technologies might be quite acceptable.

The determination of acceptable technology-site combinations could be implemented by formal governmental regulatory and economic policies, or it could be carried out in a more informal manner, such as creating ad hoc siting task forces made up of representatives of government agencies, industry, and other interest groups. Such an approach has been utilized in Utah to reach agreement on acceptable areas for coal-fired power plants in the central part of the state, thus avoiding the more scenic, southern part which contains many national parks.

Although technology-site evaluation offers great potential for clearly identifying those locations which will generate the least harmful effects, there is a risk that too stringent and rigid regulations or bureaucratic red tape could slow or block the siting process. For this reason, state policies need to be flexible. Thus it may be that an informal, ad hoc implementation strategy would not only be the least costly but also the most effective approach.

(b) Increase Citizen Participation in Siting

Some state siting procedures do not inform parties-at-interest of siting decisions until late in the process. This often leads to delaying tactics being used to slow or block development. States could implement a variety of programs to increase citizen involvement, including improving notification procedures, establishing broadly-based advisory committees, creating review boards for siting agencies, and funding intervenors.

However, it is not altogether clear that increased participation in the siting process by parties-at-interest can or even should speed up the location of individual facilities. Indeed, efforts to improve the citizen involvement may directly conflict with the desires of policymakers to reduce the complexity of siting. That is, as more groups participate and diverse interests are expressed in the siting process, time and money costs of siting may also increase. But if different values and interests can be fully expressed early in the siting process developers may be assured of greater certainty that siting decisions will not be reversed after they have been made.

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[1] North Dakota Energy Conversion and Transmission Facility Siting Act, North Dakota Century Code, Chapter 49-22-10.

13.3.4 Indians

Indian lands in the eight-state study area contain abundant and accessible energy resources, particularly coal and uranium. Thus Indians are important actors in energy policymaking as mineral owners. Further, Indians can significantly affect the development of non-Indian resources.

In many respects, Indian tribes are similar to local and state governments in terms of the problems they face, their responsibilities, and the responses they may pursue. However, the trust relationship with the federal government also places Indian tribes in a unique position in the political system, and their responses to energy development will depend on how relationships with public and private sector interests evolve and on their own values regarding development and self-determination.

A. Impacts and Issues of Concern to Indian Tribes

Cultural and lifestyle issues are among the most critical issues for Indians in regard to energy development. In fact, some tribes have decided not to develop their resources rather than to accept what they consider to be likely negative cultural and lifestyle impacts. In other tribes, potential cultural and lifestyle impacts have increased tensions among different segments of tribes which often hold conflicting views toward energy development.

If Indians do decide to develop energy resources within the reservation, they will face most of the energy-related problems and issues experienced by state and local governments. The most serious problem areas are likely to be growth management--especially providing adequate housing, water and sewer facilities, and public services--and land rehabilitation. Whether or not Indians allow development on their reservations, environmental issues will be important to them. Among the most visible and contentious of these issues is water rights, particularly Indian claims to reserved water rights and the resolution of Indian rights in state courts. Indian lands will also face air and water quality degradation from energy development.

B. Policy Responses

(1) Mineral Leasing

The most basic question Indians must answer is whether to encourage or discourage development. In this regard, Indians can influence mineral leasing arrangements, since both tribal approval and concurrence by the Secretary of the Interior are required before Indian lands can be leased. Although the extent of Indian control in this process seems to vary, the trend seems to be to give tribal leaders more control, including allowing them to consider joint ventures, production sharing agreements, and other legal arrangements with developers.[1]

In fact, Indians have already been exercising this kind of control, in some cases without approval of the Department of the Interior (DOI). For example, the Jicarilla Apaches have successfully developed joint ventures in oil and gas resource development, and other tribes have proposed agreements for variable rather than fixed royalty rates, production sharing agreements, and service contracts. Further, several tribes have either petitioned DOI or filed suit against DOI to negate leases previously negotiated because of alleged procedural irregularities or failure of the Secretary of the Interior to uphold his trust responsibilities.

These cases are important as indications that Indians have been gaining power to control their resources, and they also demonstrate that mineral leasing arrangements provide Indians an opportunity to require developers to help mitigate the impacts of development. For example, tribes can stipulate environmental protection measures, growth management assistance, and local Indian employment as part of the lease arrangement. By imposing such requirements, Indians take the same risk states take when they place high costs on resource development through such measures as high severance taxes; that is, developers may decide to develop in less costly areas.

(2) Water and Air Resources

Indian tribes and energy developers on Indian lands must comply with federal environmental statutes, including those regulating air quality, noise, water pollution, solid wastes, reclamation and safe drinking water. In addition, other legislation specifically addresses minerals development on Indian lands, including preserving cultural, recreational, scenic, and ecological values.[2] Implementation of these regulations is the responsibility of the Bureau of Indian Affairs (BIA) superintendent. However, the role of Indians in setting and implementing environmental standards and regulations is still ambiguous, largely because

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[1] DOI published proposed regulations to this effect in April 1977, 42 Fed. Reg. 18083-99 (April 5, 1977). However, as of November 30, 1978, these regulations had not been finalized.

[2] 25 CFR 177.4 (1974).

Indian tribes are often not explicitly identified in federal statutes,[1] including statutes which call for implementation by state governments and provide funding assistance to state and local governments.

The current approach to environmental protection, particularly EPA's federal-state-local approach to establishing and implementing environmental protection regulations, increases the difficulty which Indian tribes have in planning for, attracting, or controlling energy development options. This is in part because Indian authority is often unclear but also because Indians, like state governments, are largely dependent on developers and the federal government. It also apparently adds to conflicts among Indians and state governments, since each tends to fear the other's environmental planning objectives.[2] Indian responses are also affected by the limited authority Indians have over non-Indian activities on Indian lands. For example, Indian tribes have no authority to enforce tribal laws on non-Indians on the reservation without specific Congressional authority,[3] and such authority does not exist in present environmental laws.

In spite of these general limitations, Indians have been able to influence water availability and air quality policies. Although the full extent of Indian influence on water availability in the West is still not clear, their potential influence is considerable because of the reserved rights doctrine.[4] Indians have already claimed the right to substantial quantities of water in the Colorado River Basin, and if these claims are granted or if Indian water rights in general are quantified, development in the Colorado River Basin could be restricted or Indians could gain more control over development by controlling water supplies. Indians have also used air quality regulations to restrict development, most notably in the case of the Northern Cheyenne's redesignation of their reservation to Class I PSD status. This redesignation contributed to EPA's decision not to approve the PSD permit for Colstrip power plants 3 and 4.[1] Indians could also use PSD classifications to encourage development, by reclassifying to Class III.

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[1] Indians are mentioned more frequently in recent environmental legislation: for example, the 1977 Clean Air Act specifically establishes Indian authority in PSD redesignation procedures. See Clean Air Act Amendments of 1977, Pub. L. 95-95, 91 Stat. 685.

[2] This thesis has been developed in: Schaller, David A. "An Energy Policy for Indian Lands: Problems of Issues and Perception." Policy Studies Journal, Vol. 7 (Autumn 1978), pp. 40-49.

[3] Oliphant v. Suguamish Indian Tribe,___U.S.____, 98 S.C.t. 1011 (1978).

[4] Reserved rights recognize that when the U.S. establishes a federal Indian Reservation, a sufficient quantity of unappropriated water is reserved to accomplish the purposes for which the land was reserved. The reservation doctrine has been affirmed in court to hold that reserved rights are not subject to state appropriation laws. Refer to Chapter 4.2.2 for an elaboration.

(3) Growth Management

Although the external powers of Indians were terminated when they entered a trust relationship with the federal government, tribes still possess powers of self-government, except as modified by treaty or express provisions of federal legislation. These powers include independence from state governments unless Congress has expressly granted state authority.

Ironically, although this situation grants some degree of authority to Indian tribes, it also serves to increase their dependence on other governmental units or the private sector since, like local governments, Indian tribes generally do not have the taxing powers necessary to respond adequately to growth management problems. Thus, although tribes may receive substantial economic benefits from development, they will usually require support from the BIA, state governments, or developers, unless assistance has been made part of the lease arrangement. As with local governments, assistance will be needed primarily for front-end money to provide health care, water, sewers, and other public services.

Each of these potential responses by Indians to energy development raises more fundamental questions regarding Indian values and the role of the federal government in Indian affairs. Considerable diversity appears to exist among Indian tribes regarding the attractiveness of development and the relative advantages of self-determination compared to the protection of the trust relationship. For most tribes, complete isolation is not an option. Rather, when faced with the question of whether to develop their energy resources, the choice is not whether tribal members will be exposed to different cultures and lifestyles, but whether to increase existing exposure. If they choose to intensify their exposure, current trends suggest they can realize many economic benefits from development, yet will also be dependent on other policymakers for growth management assistance and environmental protection. Further, increased Indian participation in energy policymaking will probably make traditional federal-Indian relationships obsolete in the sense that the BIA will be incapable of protecting and deciding what is best for Indians.

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[1] This case is currently under appeal by Montana Power Company, which argues that a PSD permit is not required since units 3 and 4 were under construction prior to the redesignation. Refer to Chapter 6.2.

13.3.5 Federal Responses

Federal policymakers are likely to have the broadest responsibility for dealing with the consequences of western energy resource development. Pressures for federal responsibility, which in general have been increasing, originate from many sources, but include primarily the following:

- Environmental problems have steadily come under national control during the past two decades. Federal agencies now have primary authority in formulating air quality, water quality, waste disposal, and reclamation policy.
- The National Energy Plan's[1] emphasis on development of domestic resources and the fact that western energy will be used primarily to meet energy demands outside the West suggest that solutions for problems caused by development will have to be national in scope. Further, conflicts about the equitable distribution of costs and benefits of development among various regions will create pressures for federal intervention.
- Several potential problems appear to be beyond the capacity of other levels of government, either because financial resources are inadequate or because federal laws and regulations prevent other levels from assuming control.
- The federal government owns about 35 percent of the total land area in the eight states and substantial percentages of the energy resources, including about half of the coal, uranium, and geothermal and about 80 percent of the oil shale resources.

Although the federal government can intervene in many policy areas, comprehensive national control of problems associated with western development is limited by several factors, especially the fragmented nature of the federal energy policymaking system (see Chapter 1). Also, a limited role is consistent with the explicit desire of the Congress to restrict federal involvement in some areas of energy policymaking. For example, although the federal government has assumed primary responsibility for environmental protection, major air and water quality legislation expressly reserves to the states primary planning, implementation, and enforcement responsibility.[1] Another limiting factor is increased demands by western states for control over their own futures. As discussed in Chapter 2, these demands have been particularly strong regarding water resource management and reclamation. Hence, it may be difficult for the federal government to respond to needs perceived to be primarily regional or local. Further, federal assistance and expertise are limited. In an era of increasing concern about tax levels, inflation, balanced budgets, and the appropriateness of federal as opposed to state and local responsibility, comprehensive federal management of western energy development will be politically and economically controversial.

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[1] The National Energy Plan is a 5-part energy legislation package including the following parts: Utility Regulatory Policies Act, Pub. L. 95-617, 92 Stat. 3117; Energy Tax Act, Pub. L. 95-618, 92 Stat. 3174; National Energy Conservation Policy Act, Pub. L. 95-619, 92 Stat. 3206; Powerplant and Industrial Fuel Use Act, Pub. L. 95-620, 92 Stat. 3289; Natural Gas Policy Act, Pub. L. 95-621, 92 Stat. 3350.

A. Consequences of Energy Development at the Federal Level

Although every problem area discussed in this report has national implications, environmental quality and water availability rank high among the problem areas most likely to continue to attract the attention of the federal government. Our analysis suggests that the following are among the most critical of these unresolved problems which will require action at the federal level:

Air Quality

- Best Available Control Technology (BACT) requirements could sharply reduce the demand for western coal, and rigid regulations to define BACT would ignore the importance of locational factors in determining air quality problems;
- Emissions offset policies allow development in some areas of the country which already violate ambient air quality standards, while PSD policies can constrain economic development in the West;
- Ambient concentrations of pollutants from energy related population increases will often exceed those of energy facilities, yet local areas have virtually no control over these urban sources of pollution.

Water Quality

- Few western communities will be able to afford the costs either of upgrading treatment capacities to meet the demands of an increased population or of installing secondary and tertiary treatment required by the Federal Water Pollution Control Act (FWPCA);

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[1] For an elaboration of the federal-state relationship in air and water quality, see Jones, Charles O. "Local-State-Federal Sharing in Air Quality Control." Publius, Vol. 4 (Winter 1974); and Lieber, Harvey. Federalism and Clean Water. Lexington, Mass.: Lexington, 1975.

- Salinity problems will continue in part due to agricultural run-off, but also because of increased water use for energy and municipalities. Most salinity control alternatives are expensive and thus may require federal subsidies or support.

Reclamation

- The potential success of revegetation is uncertain in all areas of the West, but particularly in the arid Southwest. Current federal policies have tended to limit state authority and have restricted available options, such as redevelopment, for returning land to productive uses.

Water Availability

- Although water availability will continue to be a problem of state and regional concern, the implications of water shortages will also increasingly influence federal policies. Shortages will exacerbate environmental problems such as instream values and preservation of wilderness areas; are directly related to salinity control problems; and threaten western energy resource development and agricultural production.

In addition to these categories of problems, growth management and housing issues discussed above, as well as transportation and capital availability problems are likely to require response by the federal government. Federal policies may be required to help energy impacted areas meet the capital cost requirement of new facilities, to ensure that the capital necessary for new home construction is available, to reduce the economic risks associated with building large energy development facilities, and to encourage and control the expansion of transportation capacities to move energy materials and products from the West to other regions.

B. Policy Responses at the Federal Level

Table 13-4 summarizes federal policy alternatives for responding to the problems of western energy resource development. What follows is not intended to repeat material from Chapters 4-12, but rather to address more generally the federal role in three important areas of concern: (1) financial and technical assistance to other levels of government; (2) policies to encourage either the exportation of coal or mine-mouth conversion; and (3) the federal role in setting standards and regulations.

TABLE 13-4: POLICY ALTERNATIVES FOR THE FEDERAL GOVERNMENT

CATEGORY OF RESPONSE	FEDERAL POLICY ALTERNATIVE	CHAPTER REFERENCE
Financial and technical assistance	Assistance to impacted communities	
	Financial assistance for capital improvements (e.g., wastewater treatment)	9.3, 5.3
	General impact assistance	9.3, 12.3
	Financial assistance to increase housing stock	8.3
	Technical assistance, including information and planning to impacted communities	9.3, 12.3
	Research, development, and demonstration programs for improved technologies	6.3
	Financial programs to enhance water resource management	
	Fund desalination plants	5.3
	Augment water supply	4.3
	Assistance to the private sector	
	Programs to enhance capital availability	10.3
	Programs to expand energy transportation capacity and mitigate adverse impacts	11.3
Siting	Export Coal	
	Require federal coal to be exported	
	Encourage nonfederal coal to be exported	
	Comprehensive land use and siting programs	
	Encourage cooperative siting procedures	12.3
	Control land use on federal and public lands	7.3
	Improve the participation process in siting	12.3
Standards and regulations	Improve standards to protect and conserve natural resources	
	Requirements for water conservation	4.3
	Holding pond design and maintenance	5.3
	Interstate pollution	6.3
	Allow more variation and flexibility to account for regional and locational circumstances	
	Municipal wastewater treatment	5.3
	Reclamation	7.3
	Best available control technology	6.3
	Water conservation	4.3

(1) Financial and Technical Assistance

As shown in Table 13-4, federal policymakers have several alternatives for providing financial and technical assistance to the western region. Three categories of these alternatives are discussed below: assistance to impacted communities and to citizen groups; research, development, and demonstration (RD&D) programs; and financial programs to enhance water resource management. Most of these alternatives increase the capacity of other policymakers and jurisdictional units to solve their own problems, and generally require federal action either because of the size of the financial commitment needed, or because enactment of the alternative would be beyond the authority of other levels of government or private sector decisionmakers.

(a) Assistance to Impacted Communities and Citizen Groups

The federal government already has a number of impact assistance programs, including sharing royalties and other revenue from development on federal lands with states and localities,[1] a variety of loan programs,[2] and assistance programs targeted for specific impacts.[3] However, very little about these approaches is beneficial to western communities impacted by energy development largely because they are not directed towards small communities or because they don't provide enough assistance soon enough.

Alternatives to provide more direct assistance to western boomtowns include:

- Funds targeted to specific problem areas, particularly wastewater treatment and street construction, which go directly to impacted communities, rather than through states;

- General impact assistance channeled directly to impacted communities, which could be used at the discretion of town governments to provide planning, services, and facilities;

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[1] These include the Public Lands-Local Government Funds Act, Pub. L. 94-565, 90 Stat. 2662, 31 U.S.C. 1601 et seq.; the In Lieu of Tax Payment Act, and the BLM Organic Act.

[2] One of the more significant of these was the proposed Energy Impact Assistance Act of 1978, S. 1493 (Hart-Randolph Bill).

[3] Such as the Coastal Zone Management Act of 1972, Pub. L. 92-583, 86 Stat. 1280.

- Assistance to private sector lenders and builders in order to increase the supply and mix of housing opportunities (apartments, homes, and townhouses).

Our evaluation of these alternatives indicates they could reduce many of the problems experienced by most energy development areas. However, they will probably not be successful if they are administered as the past federal efforts at impact assistance have been. Successful use of impact assistance requires front-end money before large population increases occur, programs which are specifically targeted to impacted communities rather than counties or school districts, and local administration of grants so that each impacted community can respond to its own particular problems and needs. Implementing these alternatives to meet these requirements appears to face two serious constraints. First, better methods of anticipating impacts and identifying impacted communities will be required, hence, the success of impact assistance may depend on better technical assistance, particularly improved information systems. Second, intergovernmental jurisdictional problems, particularly federal-local-state coordination bottlenecks, will have to be resolved.

A pervasive problem for local governments and citizens' groups in trying to respond to energy-related problems is inadequate and untimely information about where, when, and at what scale development will proceed. Further, since so many local governments impacted by western energy resource development have little or no planning capacities or past experience in dealing with energy development, policy responses which attempt to creat better, up-to-date information systems also need to provide assistance in using the information. These two considerations were included in the unsuccessful Energy Impact Assistance Act of 1978[1] (the "Hart-Randolph Bill"). This bill would have provided impact assistance teams composed of federal, state, and local officials which would assess likely impacts of energy facilities and identify sources of assistance. Teams would also prepare a mitigation plan for dealing with immediate impacts and procedures for establishing a continuing planning capability. Other proposals have suggested that information and technical expertise be provided to citizen groups in order to improve the quality of participation in siting decisions. Since expertise about development technologies is increasingly a requisite for effective citizen involvement in energy policy, technical assistance could include attorney fees, expert witness fees, and other reasonable costs of developing technically competent response capabilities by citizen groups.

Technical assistance is not solely a federal responsibility--indeed states and energy developers can do much to alleviate financial, informational, and planning difficulties. However, federal activity would appear to be most effective in improving the quality of information about development and improving the capacity of other policymakers to use information and obtain financial assistance to cope with development problems. It is clear that local areas want local people for these kinds of jobs, largely because planning for energy-related impacts is inherently a political process which helps to determine the distribution of costs and benefits of development. Thus, alternatives which provide "outside" experts to local areas--whether they be federal, state, or from other areas within the same state--are not likely to be successful. And, even alternatives which try to mix federal, state, and local teams, such as the proposed Hart-Randolph Bill,[1] are less likely to succeed than options which allow local governments to improve, but ultimately control, their own planning and response abilities.

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[1] Energy Impact Assistance Act of 1978, S. 1493 (Hart-Randolph Bill).

Regarding technical assistance to citizen groups, improving the information base for various interest groups, while perhaps valuable in increasing the equity of participation, is also likely to delay the siting process. Although there is little direct experience to draw from, the recent history of conflict between environmental interests and energy developers suggests that equitable and more informed participation would not necessarily contribute to consensus or compromise about how and where development should proceed. Instead, it may serve to polarize various viewpoints even further. Thus, the attitudes and behavior of various participants will ultimately determine the success of these policy responses. The biggest question appears to be how to select a few groups to fund or assist from among many competing interests, and funding itself may artifically increase the number of participants and thus the complexity and uncertainty of siting processes.

(b) RD&D Programs for New Technologies

Although energy developers can be expected to increase investments in RD&D this option is probably one of the most important long-term strategies that can be pursued by the federal government. Joint federal, industry, and state funding for RD&D could improve both energy production and conversion systems and specific environmental control technologies for those energy resources and environmental problems which are important for the West.

Several energy production and conversion technologies considered in this study have some attractive features but are not yet commercially viable. For example, coal synfuels appear to be less problematic than electric power plants regarding the two biggest constraints on western energy development, air quality and water availability. Commercial scale demonstration programs could be directed at coal synfuels, oil shale, and geothermal resources, and since the costs of such demonstration projects can be quite large (e.g., $1 billion for a coal synfuel plant) federal participation is probably required. Regarding environmental control technologies, the most important for minimizing impacts of western energy development are technologies for: reducing air pollution (e.g., improved flue gas desulfurization systems, fluidized beds and coal cleaning); minimizing land impacts (e.g., improved reclamation methods in arid climates); and minimizing water quality threats (e.g., low cost methods for treating municipal wastewater, such as land applications).

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[1] Energy Impact Assistance Act of 1978, S. 1493 (Hart-Randolph Bill).

These alternatives are long-term in nature and provide no certain solutions. However, the benefits would be to reduce uncertainties about energy hardware and its impact on the social, economic, physical, and ecological environment, and to provide more options for increasing energy supply. The major constraint is the large financial outlays required by the federal government and other participants including private industry and possibly states.

(c) Financial Programs to Enhance Water Resource Management

There appear to be no uniform or region-wide strategies for dealing with water resource management problems, and western states, local governments, interstate commissions, and parties-at-interest will ultimately have to decide how most of the region's scarce resources should be used and how rights should be allocated. However, it is almost certain that western policymakers will require federal support, including financial aid, regulatory incentives, and cooperative help to manage water resources adequately.

Regarding water quality, impacted communities are almost totally dependent on federal funds to construct adequate wastewater treatment facilities. However, previous federal attempts to address municipal wastewater treatment through multibillion dollar public works programs funnelled through state governments have been largely unsuccessful, both in getting funds to municipalities and in accomplishing desired water quality improvements. Unless federal policymakers are willing to establish new programs specifically directed at energy boomtowns, the current regulatory structure is more of a hindrance than a help to impact mitigation since it establishes very strict requirements without providing the necessary assistance for meeting the requirements. An alternative federal response is to allow variances in either the goals or the technologies for meeting the goals of wastewater treatment for energy impacted communities.

In dealing with salinity in the UCRB, the two most effective alternatives are desalination plants and controlling runoff from irrigated agriculture, both of which are likely to require federal money because of construction costs of the technologies involved.

Costs are particularly high for desalination plants (approximately $250 million per plant). If policymakers require technologies to improve irrigation efficiency, many western farmers will be incapable of absorbing construction costs without substantial financial help.

The federal role in water availability issues will depend in large part on how much water augmentation is feasible. If policymakers choose to augment supplies through diversions and transfers, weather modification, or vegetation management, a direct federal role either in funding or providing the necessary regulatory structure will be required. If policymakers choose to emphasize conservation rather than augmentation by minimizing water consumed in energy resource development, in irrigated agriculture, or in municipal use, the federal role would shift away from direct programmatic and financial support to providing economic and regulatory incentives for various water users to conserve. For example, economic incentives could be provided to encourage water-saving cooling technologies, guarantees could be provided to farmers for crop switching because of the high risk associated with marketing water-conserving vegetable crops, and federal grants could be withheld from municipalities which do not attain minimum conservation levels.

(2) Coal Export v. Mine-Mouth Conversion

As discussed above in the section on state level responses, several alternatives exist for improving the site selection process. Although this process is largely a state-level function, the federal government can play a significant role to improve this process, including policies to encourage more cooperative siting procedures to control land use on federal and public lands, and to improve the access to policymaking on siting (see Table 13-4).

A more fundamental alternative regarding site-selection is for the federal government to encourage the export ("strip and ship") of coal rather than mine-mouth conversion.[1] This alternative is apparently being taken seriously by many policymakers and parties-at-interest, primarily on the grounds that export would minimize many of the environmental (particularly air and water quality) and growth management problems likely to occur with mine-mouth conversion. However, our analysis of the trade-offs associated with this alternative suggest that it could be extremely difficult to accomplish and, more importantly, generally ineffective in the sense of balancing economic, energy, and environmental goals nationwide.

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[1] Exporting oil shale, geothermal resources, and uranium without some on-site processing and/or conversion, is generally infeasible.

One major consideration is the trade-off between the environmental consequences of an export policy and the economic costs to the western states. Many of the revenue advantages of on-site conversion would be exported along with the resources. Although state governments could still benefit from extraction and severance taxes, localities would receive few of the economic benefits expected from mine-mouth conversion. Additionally, on-site conversion is sometimes less expensive than export for conversion at a load center outside the region; thus, export could increase energy costs ultimately borne by the consumer.

Exporting coal also raises questions about the environmental and health risks associated with load-center conversion. The most serious risks appear to be associated with air quality, because many more people would be affected at load centers than if resources were converted in the West. If load center conversion increases ambient air concentrations up to the level of current standards, this policy option could increase human health risks in other regions in order to minimize growth management, housing, and environmental problems such as PSD in the West. If load center conversion had to be increased in nonattainment areas because of this policy, economic costs would be further increased to meet EPA's emissions off-set policy.

Coal export does not appear to be a realistic comprehensive regional strategy for dealing with the problems of energy development in the West, in part because of these economic costs and environmental risks and because of the general constraints on comprehensive federal action identified above. That is, problems which are avoided in the West will often arise elsewhere. Coal export also appears to be unrealistic as a comprehensive policy because of the diversity of values and interests associated with western energy development. As has been shown throughout this report, perceptions about how much and where development will occur, what kinds of controls and constraints should be placed on it, and how serious the costs and risks are, vary dramatically among various levels of government, from agency to agency, within particular departments, across geographic areas, and among various parties-at-interest. Taken together, these factors suggest coal export is probably not an option for the region as a whole, but may be a strategy pursued by particular interests for particular areas. Hence, developers may choose to export resources in some areas rather than pay the costs of strict environmental controls; or some states may effectively eliminate mine-mouth conversion in some areas because of water scarcity, for example.

(3) Environmental Standards and Regulations

Two general patterns emerge from our analysis regarding the future federal role in the development of environmental standards and regulations (see Table 13-4). First, resource development in the West will create several potential environmental and natural resource problems which are currently uncontrolled or inadequately controlled. Second, the typical response of federal regulators to establish uniform standards must be questioned as an appropriate strategy for achieving environmental goals, particularly regarding environmental quality in the western region. Each of these is discussed below.

(a) Regulate Emerging Threats to Natural Resources

As noted above, energy resource development will create or add to several environmental and natural resource problems. The most serious of these, which may require new or expanded federal standards or regulatory policies, include long-range transport of air pollutants and control of pollution from holding ponds.[1]

Long-range transport of sulfates and fine particulates could extend pollution problems over considerable distances from energy facilities, and air quality outside the eight-state study region could be adversely affected. Although the extent to which long-range transport could occur is not known, regulation to control air pollution problems across political jurisdictions will add to intergovernmental and economic conflicts over air quality control. This is particularly likely if pollution originating from one area restricts development in another, for example, by contributing to an area's nonattainment status; or if pollution in one state contributes to PSD violations in another. For example, this could apparently be the case as air pollution from Utah is transported to Colorado.

Control of pollution from holding ponds is not necessarily an area solely left to federal regulation--indeed states can regulate the design, construction, maintenance, and monitoring of holding ponds to reduce the probability of berm failure or seepage of pollutants. However, three factors suggest federal intervention may be required. First, western states in general have not directly regulated the safety of holding ponds, although some state guidelines and direct regulations of water contamination do exist. Second, the use of ponds could dramatically increase as scrubbers are used to meet federal BACT requirements and, thus, result in increased sludge which must be disposed of. Third, the FWPCA contributes to the economic incentives leading to the use of ponds in the first place, since it is cheaper for developers to discharge wastes into ponds than to treat the effluents to the degree necessary to meet the discharge requirements of the FWPCA.

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[1] New standards may also be required to limit concentrations of pollutants such as sulfates and to protect visibility. See Chapter 6 for an elaboration of these problems.

Federal control of holding ponds could be accomplished either through the FWPCA[1] and Clean Water Act (1977),[2] since discharges from ponds pose a threat to surface waters and ponds could be defined as a point source, or the Resource Conservation and Recovery Act (1976),[3] which provides for a nationwide system for managing hazardous waste. Since discharges to holding ponds almost certainly contain heavy metals and may contain trace quantities of toxic substances, these discharges appear to fall within the scope of "hazardous materials." Whichever regulatory apparatus is used to control these materials, several potentially effective alternatives exist, including:

- Requirements for ponds to be lined with the best available materials to reduce chances of seepage;
- Requirements for pond design which minimize chances of berm failure or of pollutants being washed out by flash floods;
- Requirements for pond monitoring and use of penalties for pond failure;
- Requirements for pretreatment of effluents before they are discharged into ponds.

(b) Increase the Flexibility of Standards

The federal response to environmental controls has generally been to set uniform standards. This has been true in a variety of policy areas, including reclamation, air quality, water quality and others; and has been justified on the grounds that the standards identify minimum pollution levels acceptable to human health and welfare (e.g., ambient air quality standards) or that the standards establish minimal conditions of acceptable environmental quality (e.g., reclamation). In most of the legislation establishing these standards, concern was expressed regarding the inability or unwillingness of other levels of government or the private sector to control adequately the particular problem; and air quality and water quality legislation adopted since 1970 has been, in large part, the result of a 10 to 15 year history of state inactivity in protecting the environment.

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[1] Federal Water Pollution Control Act Amendments of 1972, Pub. L. 92-500, 86 Stat. 816.

[2] Clean Water Act of 1977, Pub. L. 95-217, 91 Stat. 1566.

[3] Resource Conservation and Recovery Act of 1976, Pub. L. 94-580, 90 Stat. 2795.

Much of this body of environmental protection legislation has been valuable and successful, and leaving intact, if not strengthening, much of the existing regulatory structure seems to be justified. However, as more is learned about the impacts of western resource development on the environment, it becomes clearer that uniform, mandatory requirements may not be the best approach to environmental problems.

The issue which best illustrates the problem of uniform regulation is reclamation. The success of reclamation will depend, in large part, on several locational factors which vary considerably across the eight-state region, including climate, soil, topography, and existing biological communities; but the most important is rainfall and, particularly, seasonal distribution of rainfall. Since most of the region is arid or semiarid, the success of reclamation (i.e., returning lands to their predevelopment use) is uncertain in most areas and will be particularly difficult in Arizona, New Mexico, and southern Utah, and will probably require long-term commitments to irrigation in an area already facing serious water availability problems.

Knowledge of these locational variations challenges existing federal regulatory structure, specifically the 1977 Surface Mine Reclamation Act,[1] which has removed state flexibility in responding to reclamation questions by establishing a blanket policy of returning disturbed lands to their predevelopment use. Our analysis of one alternative to this policy, redevelopment (i.e., returning lands to some other beneficial use, such as parks), does not suggest that either of these two general choices is the single best option. In fact, both choices appear to be limited or impractical in many areas. However, it does suggest that other choices, such as the established need for expanded recreational opportunities for energy related population increases, should be seriously considered as alternatives to reclamation, particularly in areas where reclamation will be difficult, expensive, and its success questionable. This does not suggest that the negative effects of surface mining should not be regulated. It does suggest the need for a more flexible policy which allows local determination of needs and provides for choices among reclamation, redevelopment, or other alternatives.

In addition to reclamation, similar questions about uniform policy responses can be raised in at least three other areas:

- Requirements for 85 percent sulfur dioxide (SO_2) removal: although a final EPA decision has not been made at the time of this writing, EPA apparently favors this uniform BACT requirement, rather than a sliding scale which allows a lower percentage removal for low sulfur coal use. Considerable uncertainty exists about both the costs and benefits of this proposal, particularly regarding how much energy production costs will increase and whether or not this policy will reduce SO_2 emissions more or less than a sliding scale would. This policy would appear to limit the development of new control technologies, decrease power plant efficiency, cause a large increase in waste disposal problems, and increase water consumption.

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[1] Surface Mining Control and Reclamation Act of 1977, Pub. L. 95-87, 91 Stat. 445.

- Background pollutant levels: in some areas of the West, background pollutant levels of particulates, hydrocarbons and ozone which apparently originate from natural sources, have been measured at or above federal standards. For example, total suspended particulates are largely due to wind-blown dust composed of large particle-sized inorganic materials not considered a health hazard by EPA. These background levels could restrict energy development unless regulations take them into account.

- Water conservation: pressures will increase for mandatory conservation by water users, particularly for energy developers. However, uniform requirements, for example, for "best available conservation practices," would ignore critical locational variables, such as water availability and cost. Thus, more flexible choices such as water ceilings or sliding pricing systems, should be considered.

Pointing out areas where uniform regulatory approaches may be inappropriate does not suggest that these critical areas of environmental control should not be regulated. Rather, it suggests that the regulatory structure should be flexible enough to accommodate locational circumstances. This need will challenge implementation procedures of both federal and state governments. Further, flexible policy responses inevitably raise questions about how equitably costs and benefits of development will be distributed. There are no simple answers to this question, because many policymakers view standardized policies which apply the same regulation across all circumstances to be fair and equitable, while others define equity in terms of freedom from bias or favoritism. However, it does seem relatively clear that uniform standards and regulations do not necessarily lead to the most effective and efficient choices in controlling environmental problems.

13.3.6 Energy Developers

This section focuses on the role of energy developers, which includes corporations such as coal and oil companies and regulated gas and electrical utilities. Energy developers have the direct authority and responsibility for initiating energy development plans. They will decide, for example, whether to "strip and ship" coal or to convert it at the mine-mouth to electricity or synthetic fuels; whether to use conventional or solution mining of uranium; and whether to build commercial scale oil shale production facilities. The principal criterion for making such choices will be economics. The limitations which economic factors place on decisions made by energy developers will depend on the nature of the market, the degree to which the company is regulated economically, the costs to comply with government laws and regulations, and the degree of support and/or opposition from various interest groups. For these reasons energy developers increasingly are forced to depend on others who have a stake in the system.

A. Consequences of Concern to Developers

The most obvious consequence of western energy development for the energy industry is the opportunity for profitable investments. Between 1975 and 2000, for our Low Demand case,[1] energy extraction, conversion, and energy transportation facilities in the eight-state study area could require an estimated investment of more than $100 billion (in 1975 dollars) (see Chapter 10). Investing such a large sum should provide substantial economic benefits for the region, for the nation, and for the companies involved.

However, in estimating economic benefits of development opportunities, energy developers must also be concerned with the variety of problems and issues which such development creates. For example, siting requirements, environmental constraints, and possible adversary actions are some of the consequences which will directly affect the decisions of developers, either by increasing the cost of producing the energy, or by increasing uncertainty about where and how to proceed with energy development.

Uncertainty about energy development plans beyond the control of the company also has economic implications. The situation surrounding the construction of two additional electric power generation units at Colstrip, Montana, by Montana Power Company (Colstrip Units 3 and 4) illustrates these uncertainties (see Chapter 6). As a result of the redesignation of the Northern Cheyenne reservation to Class I PSD and subsequent EPA requirements followed by litigation, the two power units have been delayed at least 18 months. Inflation of plant construction costs (costs have probably risen at least 10 percent per year during this period) will increase electricity costs which will ultimately be passed on to consumers.

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[1] Recall that our Low Demand tax scenario calls for a national energy production level of 124.0 Q, with contribution of 42.6 Q from the eight-state study area (see Chapter 2).

Other consequences of energy development problems may be less direct but are nevertheless important concerns to western energy developers. For example, the "boomtown" conditions that result from rapid population growth in small western communities mean a substantially lower quality-of-life for the residents; inadequate medical care, housing, and recreational facilities are probable results. All of these factors can result in worker dissatisfaction, leading both to lowered productivity and high worker turnover rates. For these reasons, it can be in the long-term interest of developers to take actions which minimize these problems, even though short-term costs may be increased.

B. Policy Alternatives for Energy Developers

Since energy developers are the prime movers in western energy development activities, they have the greatest opportunity to deal with the problems and issues created. As discussed above, their willingness and ability to act is often limited by practical economic considerations and regulatory uncertainties. Thus, in many cases government regulations (e.g., emission standards), or financial incentives (e.g., investment tax credits for pollution control equipment) will be required in order to achieve the desired responses on the part of energy developers.

Nevertheless, in many cases industry might adopt policy responses aimed at avoiding the conflicts which result in long, costly delays in the start of construction. While some of these policies might appear to increase project costs, the shorter time between planning and start-up may in the long run prove to be more economical. These responses can be categorized as: technological fixes, site selection, and socioeconomic impact mitigation. Policy responses within each of these categories are listed in Table 13-5.

(1) Technological Fix

As discussed in the federal section, a potentially effective policy response is RD&D programs aimed at technologies for producing and converting western energy resources which would avoid many of the problems created by present day processes. While industry might undertake these RD&D programs without government participation, the high cost and risk (especially for commercial-scale demonstrations) are beyond the capacity of all but the largest companies. Joint efforts by government and industry will probably be required for financial reasons; but they also have the additional advantage of giving credibility to the environmental studies done during the development program.

A second type of technological fix response is for energy developers to adopt "best practicable technologies" (BPT) in some situations, even if that technology is neither required by current regulations nor the lowest cost option. An example would be

TABLE 13-5: POLICY ALTERNATIVES FOR ENERGY DEVELOPERS

CATEGORY OF RESPONSE	TYPE OF POLICY	CHAPTER REFERENCE
Technological fix	Increased RD&D programs	Ch. 6.3
	Adoption of BPT	Ch. 4.3
Site selection	Construction of smaller, dispersed energy facilities	Ch. 6.3
	Consultation among industry and other parties to identify "acceptable" sites	Ch. 6.3 and Ch. 12.3
Social and economic impact mitigation	Early announcement of project plans by developers	Ch. 9.3.2
	Industry impact assistance	Ch. 8.3 and Ch. 9.3
	Reduce peak population influxes	Ch. 8.3

RD&D = research, development, and demonstration
BPT = best practicable technology

water-saving cooling technologies for coal conversion facilities. Water availability is one of the key problems associated with western energy development, especially in the UCRB, and most of the water required for the energy conversion technologies studied is for cooling. However, if water-saving cooling technologies are used, water requirements can be reduced about 60 to 90 percent for power plants and about 40 to 95 percent for coal synthetic fuel plants. It is true that in most areas in the eight-state study area, the price of water is low enough so that it is not economically attractive to use these water conserving technologies. However, if they were employed, opposition to energy development from agricultural, environmental, and other interests might decline, and a higher overall level of energy development with a given amount of water could be possible.

A similar example of BPT is improved holding pond designs for the disposal of wastes. Once again decisions which are "economically optimum" for that particular facility or company at a particular time, may not be the best strategy when examining the total picture over the longer term. By adopting a BPT viewpoint, the energy industry might substantially reduce many of the problems and issues before they become barriers to development.

(2) Site Selection

Energy developers may also use the site selection process to reduce impacts. One alternative in this category, discussed in Chapter 6, is to construct smaller, dispersed energy conversion facilities rather than the more typical, large one. Although this response has been discussed in terms of meeting siting requirements by reducing air quality problems, several other possible advantages could occur, including reduced water consumption at the site, fewer social and economic impacts due to a smaller construction work force, and increased flexibility in siting. However, environmental and economic costs and benefits of this alternative will depend on many site-specific factors and thus, it is not possible to draw general conclusions. Nevertheless, because the smaller, dispersed facilities option could offer means of surmounting energy development barriers in some situations, industry should consider this alternative in its planning and site selection process.

A second type of response in the site selection category is for energy developers to cooperate and coordinate with governmental agencies and parties-at-interest in order to reach a consensus on sites acceptable for energy facilities. The goal could be to avoid the most problematic sites, thus avoiding expensive and debilitating court suits and construction delay, as happened with the now defunct Kaiparowits project. An example of this approach is the ad hoc siting task force established in Utah. (This example is discussed in the section on state responses in this chapter, and is discussed in more detail in Chapter 6.)

(3) Social and Economic Impact Mitigation

Energy developers can respond in several ways to mitigate social and economic impacts. As evaluated in Chapters 8 (Housing), 9 (Growth Management), and 12 (Energy Facility Siting), these alternatives include early announcement of project plans, direct impact assistance, and policies to reduce peak population influx during construction.

Boomtown problems are often magnified because local government officials are simply not given advanced warning of new projects and therefore have little time to plan for rapid growth. In most cases, energy developers could alleviate many of the resulting problems with very little cost, simply by providing local officials with estimates of personnel requirements and other important impacts factors, such as tax benefits. Because industry plans often change in response to government regulations and bureaucratic red tape, as well as their own choices, both developers and local governments will want to account for these uncertainties so as not to make large investments until the project plans are finalized. However, these uncertainties do not preclude cooperative industry/local government arrangements to plan for housing, retail services, sewage treatment facilities, and other "people" needs.

In addition to supplying planning information as early as possible, industry can respond more directly by providing housing and other needs for its workers. There are several examples of industry responding in this way, including ARCO's mobile home park near its Black Thunder Mine in Wyoming, the "new town" built by Montana Power Company at Colstrip, Montana, and several instances where companies have been willing to provide guarantees to home builders for a certain number of new homes (see Chapter 8). Industry could also provide for some of the infrastructure needs by prepaying property taxes, but this approach is presently discouraged by Internal Revenue Service rules which do not allow for the full deduction in the year in which the payment is made.

Reducing peak population influxes for small communities during construction could be accomplished in several ways, including encouraging long distance commuting of construction workers from outlying population centers. Possible incentives would be fleets of mass transit vehicles operated by the company or subsidized travel costs for workers utilizing their own vehicles. Of course, the feasibility of this approach depends on the location of the construction site relative to larger towns. Where it is feasible it offers the added advantage of allowing workers' families to maintain their current residence.

13.4 SUMMARY

This chapter has summarized the Policy Analysis Report, which is one of the three major reports resulting from our technology assessment of western energy resource development. Our report on Energy Resource Development Systems (ERDS)[1] describes the technologies likely to be used to develop coal, oil shale, uranium, oil, natural gas, and geothermal resources in the eight-state study area as well as the laws and regulations which will affect the development of each of these resources. Our Impact Analysis Report[2] examines both site-specific and regional impacts from the present to the year 2000 resulting from the development of typical energy resource development technologies. The purpose of this analysis was to identify specific problem areas and to identify the locational and technological factors which contribute to the seriousness of these problems.

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[1] White, Irvin L., et al. Energy From the West: Energy Resource Development Systems Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

[2] White, Irvin L., et al. Energy From the West: Impact Analysis Report. Washington, D.C.: U.S., Environmental Protection Agency, forthcoming.

This Policy Analysis Report builds on the ERDS and impact analyses by identifying problems and issues that will need to be addressed if western energy development is to proceed in a manner in which beneficial opportunities are maximized and negative consequences are minimized. The nine categories of problems and issues selected as being most important (water availability, water quality, air quality, land use and reclamation, housing, growth management, capital availability, transportation, and energy facility siting) are a result of the way we structured our study, the assumptions made, and our knowledge of the relevant social and political factors influencing energy development in the West. While other issues or other approaches to categorizing our policy analysis could have resulted from a different analytical approach, we believe these nine categories do cover the most important issues likely to arise in connection with western energy development. For each of these categories of issues, we have identified a range of policy alternatives and implementation strategies and compared and evaluated selected alternatives in order to inform policymakers about the trade-offs which can be expected from pursuing various approaches to dealing with these issues. In this chapter, we have summarized our analysis of alternatives by suggesting what Indian tribes, policymakers at various levels of government, and the private sector can do to deal with the issues most directly affecting them.

Given the complexity and uncertainty of the energy policymaking system, conclusions regarding future levels of development in the eight-state study area or where development will take place are hazardous. Nevertheless, it is clear that energy development will occur in the eight-state study area, and much is known about the problems and issues which will result and about the trade-offs which can be expected if policymakers choose various alternatives for dealing with the problems and issues.

Perhaps the most important implication of our study about western energy resource development is that the problems likely to arise in the eight-state area will go beyond the capacity of existing institutional arrangements--including state-local, federal-state, interstate and private-public sector relationships. This is most evident regarding local areas, which generally face the most difficult problems of energy development, and yet towns and counties are least able to manage energy-related problems effectively. For these problems to be dealt with effectively, considerable money, manpower, technical assistance, and information about the problems will have to be provided by states, the federal government, and energy developers. The challenge will be to develop mechanisms for anticipating these consequences and facilitating the necessary assistance. This conclusion applies to most of the other problems and issues associated with energy development. That is, many of the benefits and costs of development are known. What remains to be done is for public and private sector parties-at-interest to develop new and innovative processes for realizing the benefits while coping with the imminent and often serious negative effects of energy resource development.

GLOSSARY

AD VALOREM TAX--A tax imposed at a fixed percentage of the value of a commodity.

ALLUVIAL--Associated with materials (sand, gravel, etc.) transported by and laid down by flowing water.

ALTERNATING CURRENT (AC)--An electric current that reverses its direction at regularly recurring intervals.

AMBIENT AIR QUALITY STANDARDS--According to the Clean Air Act of 1970, the air quality level which must be met to protect the public health (primary) and welfare (secondary). Secondary standards are more stringent than Primary Ambient Air Quality Standards.

AMBIENT STANDARDS--Standards for the conditions in the vicinity of a reference point, usually describing the physical environment (the ambient temperature is the outdoor temperature, and ambient air refers to the normal air-quality conditions).

AMORTIZATION--The gradual reduction of an obligation, such as a mortgage, by periodically paying a part of the principal as well as the interest.

AQUIFER--A subsurface zone that yields economically important amounts of water to wells; a water-bearing stratum of permeable rock, sand, or gravel.

AQUATIC HABITAT--A type of site in, on, or near water where certain types of plants and/or animals naturally or normally live and grow.

AREA COUNCILS OF GOVERNMENT--Regional voluntary intergovernmental organizations. They serve the function of allowing greater cooperation and planning among local governments in solving problems that overlap more than one local jurisdiction. They also serve as a means to direct federal aid to cities.

AUGMENTATION--Increasing existing (water) supplies by adding to the quantities naturally available.

AVOIDANCE AREAS--Areas that are not to be utilized as sites for energy conversion facilities unless there are no acceptable alternatives.

BACKFILLING--A reclamation technique which returns the spoils to mined cuts or pits. This levels the land in a configuration similar to the original form.

BACKGROUND LEVELS--Ambient concentrations of hydrocarbons and particulates from natural sources, e.g., blowing dust.

BENEFICIAL USE--A doctrine derived from the appropriation system stipulating that water use must be made in accordance with the public interest of the best utilization of the water resource.

BERM--A shelf or wall built to contain spills around a fuel storage tank or to retain other liquids or semisolid materials as in waste stabilization ponds.

BEST AVAILABLE CONTROL TECHNOLOGY (BACT) REQUIREMENT--The part of the Clean Air Act which requires that a facility be equipped with the most up-to-date antipollution device. Example--coal-fired power plants equipped with scrubbers.

BREEDER REACTOR--A nuclear reactor that produces more fissile material than it consumes. This reactor is sometimes called the fast breeder because high energy (fast) neutrons produce most of the fissions in current designs.

BROWSE--Twigs, shoots, and leaves eaten by livestock and other grazing animals.

COMMODITIES CLAUSE--Section of the Interstate Commerce Act of 1887 which prevents railroads from transporting freight which they manufacture, mine, produce, own, or have an interest in. It has not been applied to any other transportation mode.

COMMON CARRIER--A transportation company which is licensed to provide its services at nondiscriminatory rates to all shippers who apply.

CONSTRUCTION/OPERATION EMPLOYMENT RATIO--The difference between the number of employees needed for the construction phase of a large project and the number needed for operation of the facility. Construction results in large employment increases, while employment declines are experienced during actual operation, resulting in the boom-bust cycle associated with large construction projects. The larger the ratio, the greater the employment decline when construction is completed.

CONVERSION FACILITY--Plant used to convert energy raw materials into usable energy forms.

CORONA DISCHARGE--A discharge of electricity appearing as a bluish-purple glow on the surface of and adjacent to a conducter when the voltage gradient exceeds a certain critical value; due to ionization of the surrounding air by the high voltage.

COST--The value of the best alternative which is foregone when an alternative is chosen.

CRITERIA POLLUTANTS--Six pollutants identified prior to passage of the Clean Air Act Amendments which now have established Ambient Air Quality Standards, i.e., sulfur dioxide, particulate matter, carbon monoxide, photochemical oxidants, non-methane hydrocarbons, and nitrogen oxides.

CRITICAL AREAS--Land in energy development areas in which energy and recreational development should be restricted.

DEPLOYMENT--Strategic or wider utilization, in this case of energy resources.

DEREGULATION--The act or process of removing restrictions and regulations.

DESALINATION--Removal of salt, as from water or soil. Also known as desalting.

DIRECT CURRENT (DC)--An electric current flowing in one direction only and substantially constant in value.

DIVERTING--Turning the course of water from one direction to another.

DRY COOLING--A method used for dissipating waste heat whereby water is circulated in a closed system and cooled by air flow similar to a car radiator.

EASEMENT--The right held by one person or body to make use of the land of another for limited purposes.

ECOSYSTEM--The interacting members of the biological community and physical components that occur in a given area.

EFFECTIVENESS--The degree to which objectives are achieved.

EFFICIENCY--The degree to which a possible course of action minimizes costs and risks while maximizing beneficial impacts.

EFFLUENT--Any water flowing out of an enclosure or source to a surface water or groundwater flow network.

ELECTRIC POWER GENERATION--The large-scale production of electric power for industrial, residential, and rural use, generally in stationary plants designed for the purpose.

ELECTROSTATIC PRECIPITATORS--Devices that use an electric field to remove solid particles or droplets of liquid from plant exhaust stack gases.

EMINENT DOMAIN--The right of a government to take private property for public use by virtue of the superior dominion of the sovereign power over all lands within its jurisdiction.

ENHANCED RECOVERY--The increased recovery from a pool achieved by artificial means or by the application of energy extrinsic to the pool, which artificial means or application includes pressuring, cycling, pressure maintenance or injection to the pool of a substance or form of energy but does not include the injection into a well of a substance or form of energy for the sole purpose of (i) aiding in the lifting of fluids in the wells, or (ii) stimulation of the reservoir at or near the well by mechanical, chemical, thermal, or explosive means.

ENVIRONMENTAL IMPACT STATEMENT (EIS)--The National Environmental Policy Act requires that an EIS be filed with any proposed federal action that will affect the environment. The EIS is to contain: a description of the proposed action; the relationship of the action to plans for the affected area; the probable impact (both favorable and adverse); alternatives to the proposed action; unavoidable adverse environmental effects; and the relationship between short-term uses and long-term productivity.

EQUITY--A risk interest or ownership right in property.

EQUIVALENCY STANDARDS--Proposal to allow farmers and ranchers in arid regions to irrigate more land with water from federal water projects than those in more humid regions. Current standards restrict irrigation to 160 acres or 320 acres if both husband and wife are owners.

EVAPORATIVE HOLDING PONDS--Holding areas into which treated water effluents are discharged (rather than into navigable waters), where solid wastes accumulate and create potentially significant surface and groundwater quality problems.

EVAPOTRANSPIRATION--Loss of water from the soil both by evaporation and by transpiration from the plants growing thereon.

EXCLUSION AREAS--Areas designated by the federal government where energy development or conversion facilities cannot be sited.

FEASIBILITY--The degree to which a possible course of action is capable of being accomplished, particularly from a technological standpoint.

FLUE GAS DESULFURIZATION (FGD)--Removal of sulfur oxide pollutants from stack gas emissions by one of several possible methods.

FORB--An herb other than grass.

FRONT-ENDED COSTS--Costs which are incurred before or at the beginning of a project.

4-R ACT--Railroad Revitalization and Regulatory Reform Act of 1976, Pub. L. 94-201, 90 Stat. 31.

GASIFICATION--The conversion of coal or organic waste to a gaseous fuel.

GAUSS--The centimeter-gram-second unit of magnetic induction equal to the magnetic flux density that will induce an electromotive force of one one-hundred millionth of a volt in each linear centimeter of a wire moving laterally with a speed of one centimeter per second at right angle to a magnetic flux.

GAUSSIAN DISPERSION MODEL--The most commonly occurring probability distributions have the form:

$$(1/\sigma \sqrt{2\pi}) \int_{-\infty}^{u} \exp(-u^2/2)du, \quad u = (x-e)/\sigma$$

where e is the mean and σ is the variance. Also known as Gauss' error curve or Gaussian distribution. A model used to measure or predict the normal distribution of air pollution.

GONDOLA CAR--Railroad car for carrying bulk materials such as coal and grain, with an open top and sealed bottom, so that emptying is usually achieved by rotating the car.

GROUNDWATER--Subsurface water occupying the saturation zone from which wells and springs are fed; in a strict sense, this term applies only to water below the water table.

"HARD ROCK" MINERALS--Solid minerals, as distinguished from oil and gas, especially those solid minerals found in hard rocks.

HIGH VOLTAGE TRANSMISSION LINE (HVTL)--An alternative method of coal transportation involving the production of mine-mouth electric power with subsequent transmission of large blocks of power on a point-to-point basis.

HIGH WET COOLING--A method used for dissipating waste heat whereby water is circulated between a condenser where it absorbs heat and a tower where the warm water is cooled by evaporation.

HOPPER CAR--Railroad car for carrying bulk materials such as coal and grain, with doors on the bottom for emptying.

HORIZONTAL DIVESTITURE--Disposal of a portion of a business which produces products which are somewhat substitutable for other products of the firm, e.g., coal produced by an oil company.

HORIZONTAL INTEGRATION--Ownership by one company of competing energy resources--coal, petroleum, uranium, etc.

HYDROLOGY--A science dealing with the properties, distribution, and circulation of water on the surface of the land, in the soil, and underlying rocks, and in the atmosphere.

IMPLEMENTABILITY--(1) The ability to carry out or put into practical effect; (2) the ability to have uniform standards incorporated in legislation and regulations.

IMPOUNDMENT--collection of water for irrigation, flood control, or similar purpose.

IN SITU--In the natural or original position; applied to energy resources when they are processed or converted in the geologic strata where they were originally deposited.

INFILTRATION--Permeation of water through the land surface into the groundwater system.

INSTREAM FLOW--Water flowing in a stream, typically with reference to a water requirement for fish and other biota.

INTERMEDIATE WET COOLING--The use of a mixture of high and minimum wet cooling technologies in power plants in order to conserve water resources. Also referred to as wet/dry cooling.

INTERMODEL COMPETITION--Competition between companies providing dissimilar modes of transportation, e.g., railroads versus trucks.

INTERMODEL UMBRELLA RATES--Protective rates allowed to be changed by companies providing the same mode of transportation.

INTRAMODEL COMPETITION--Competition between companies which are providing the same form of transportation, e.g., rail.

ISSUE--Impact, problem, or consequence of energy resource development which generates conflict among parties-at-interest.

ISSUE SYSTEM--Conceptual framework which identifies the issue being considered, the parties involved, the area in which the dispute occurs, and the decisionmaking agencies with jurisdiction.

JOINT USE CORRIDOR--A narrow strip of land with restricted boundaries in which facilities of the same or different system are placed adjacent to each other in as close proximity as practical and feasible.

LEAD TIME--The time needed for planning, financing, and construction of required facilities before they are ready for use.

LEGUME--A dry, dehiscent fruit derived from a single simple pistil; common examples are alfalfa, beans, peanuts, and vetch.

LIGNITE--The lowest-rank coal, with low heat content, fixed carbon, and high percentages of volatile matter and moisture; early stage in the formation of coal.

LINK--A connection between two points, as in a transportation system (rail, pipeline) between a supply center and a demand center.

LIQUEFACTION--The conversion of a solid fuel, such as coal or organic waste, into liquid hydrocarbons and related compounds.

LIQUEFIED NATURAL GAS (LNG)--A clean, flammable liquid existing under very cold conditions that is almost pure methane.

METHACOAL--A coal slurry using methyl alcohol instead of water.

METHYL FUEL--An alkyl radical CH_3 fuel derived from methane by removal of one hydrogen atom.

MILLING--A process in the uranium fuel cycle by which ore containing only 2 percent uranium oxide is converted into a compound called yellowcake which contains 80 to 83 percent uranium oxide.

MINE DEWATERING--Pumping unwanted groundwater from a mine in order to achieve adequate mining conditions.

MINE-MOUTH SITING--Location of a facility in the vicinity or area of a mine, usually within several miles.

MINIMUM WET COOLING--A method used for dissipating waste heat whereby water is circulated in a closed system and cooled by air flow similar to a car radiator. Also known as dry cooling.

MIXING AND DILUTION--The dispersion of pollutants into the atmosphere resulting in a reduction in the level of concentration.

MOBILE SOURCES--Nonstationary sources of air pollution such as automobiles, trucks and buses; as defined by the Clean Air Act Amendments of 1977.

NATIONAL AMBIENT AIR QUALITY STANDARDS--Pollution standards established by the Clean Air Act Amendments of 1970 requiring a 90-percent reduction of automotive hydrocarbon and carbon monoxide emissions from 1970 levels by the 1975 model year and a 90-percent reduction in nitrogen oxide emissions from 1971 levels by the 1976 model year.

NEW SOURCE PERFORMANCE STANDARDS--Standards set for new industries to ensure that ambient standards are met and to limit the amount of a given pollutant a stationary source may emit over a given time. "New" in this context applies to facilities built since August 17, 1971.

NOMINAL CASE--One of the three levels of energy development used to make projections based on the energy model developed for Gulf Oil Corporation by Stanford Research Institute.

NONATTAINMENT AREAS--(1) Areas, typically urban with heavy automobile-related pollutants, in which "all available measures" will not attain ambient air quality standards by 1982. States must submit new implementation plans and must reduce emissions in the area each year to ensure that the ambient standard is attained by 1987; (2) areas where national air quality standards have not been met.

NONMETHANE HYDROCARBONS--An organic compound (as acetylene or benzene) containing only carbon and hydrogen and often occuring in petroleum, natural gas, and coal, other than the colorless, odorless, flammable, gaseous hydrocarbon CH_4.

NONPOINT SOURCES OF POLLUTION--Areawide water wastes, essentially those which are transported to surface and groundwaters from sources other than pipes and ditches. These include pesticides, fertilizers, sediments, natural salts, animal wastes, plant residues, and minerals.

OMB A-95 REVIEW PROCESS--Requirement that states provide the opportunity for governors and local officials to comment on application for federal funds to undertake a variety of categorical programs, and that agencies of the federal government consider the comments of the general public in approving specific applications for funds.

OCEAN THERMAL GRADIENTS--Differences in temperature of the ocean water at various depths.

OFF-ROAD VEHICLES--Motor vehicles such as motorcycles, snowmobiles, and four-wheel drive vehicles that can operate over natural terrain without the need for roads.

OFFSET PLAN--EPA policy which permits new facilities to be sited in nonattainment areas where concentrations of criteria pollutants exceed air quality standards.

ONE-STOP SITING--Centralized decisionmaking alternative where one commission would handle all siting decisions and seek input from all concerned parties.

ORGANIZATION OF PETROLEUM EXPORTING COUNTRIES (OPEC)--A group of nations controlling over 75 percent of free-world petroleum reserves; includes Algeria, Indonesia, Iran, Libya, Nigeria, Saudi Arabia, United Arab Emirates, Venezuela, and others.

OXIDES OF NITROGEN--A class of air pollutants which includes several forms of the compound (NO, NO_2, NO_3 as well as others). Oxides of nitrogen are produced during combustion and constitute some of the reactants involved in the formation of photochemical smog.

OXIDES OF SULFUR--A class of air pollutants which includes several forms of the compound (SO_2 and SO_3).

OZONE--An oxidant formed in atmospheric photochemical reactions.

PARTICULATES--Microscopic solids that emanate from a range of sources and are widespread air pollutants. Those between 1 and 10 microns in size are most numerous in the atmosphere; they stem from mechanical processes and include industrial dusts, ash, etc.

PARTIES-AT-INTEREST--Individuals, groups, or organizations (such as local residents, Indian tribes, industry, labor, or various levels of government) whose interests or values are likely to be affected by the development of western energy resources.

PEAK GROUND LEVEL CONCENTRATION--The highest air pollutant density measured or predicted that is a result of human activity on the ground, e.g., automobile use. Always cited with respect to an averaging time.

PERCOLATION--Downward movement of water through soils.

PHOTOCHEMICAL OXIDANTS--Any of the chemicals which enter into oxidation reactions in the presence of light or other radiant energy.

PHREATOPHYTE--A deep-rooted plant that obtains its water from the water table or the layer of soil just above it. These plants are characteristically nonproductive vegetation,such as saltcedar, growing in stream beds, ditch canals, etc. which consume large quantities of water.

PLANNING CORRIDOR--A broad linear strip of land of variable width reserved between two geographic points which has ecological, technical, and/or economic advantages over adjacent areas for the location of transportation and/or utility systems.

PLUME IMPACTION--The point of contact between stack emissions and elevated terrain that results in high pollution concentration levels at that point.

POINT SOURCES OF POLLUTION--Those sources of water pollution which are discrete conveyances (pipes, channels, etc.) and are controlled by the effluent standards of the Federal Water Pollution Control Act Amendments of 1972. These include effluents from municipal sewage systems, storm water runoff, industrial wastes, and animal wastes from commercial feedlots.

POND LINER--The bottom of a pond, typically a specially prepared layer of clay, less permeable solids, or manmade materials.

POPULATION/EMPLOYMENT MULTIPLIER--A numerical multiplier applied to the number of workers needed to construct or operate a new facility that is used to project total population levels or increases.

POWER POOLING--The transfer of electricity among utilities in regional electrical service.

PREVENTION OF SIGNIFICANT DETERIORATION (PSD)--Pollution standards that have been set to protect air quality in regions that are already cleaner than the Ambient Air Quality Standards. Areas are divided into three categories determining the degree to which deterioration in the area will be allowed.

PRIME FARMLANDS--Land defined by the Agriculture Department's Soil Conservation Service based on soil quality, growing season, and moisture supply needed to produce sustained high crop yields using modern farm methods.

PRIMITIVE AREAS--Scenic and wild areas in the national forests that were set aside and preserved from timber cutting, mineral operations, etc., from 1930-1939 by act of Congress; these areas can be added to the National Wilderness Preservation System established in 1964.

PROBLEMS AND ISSUES--The two terms are not synonyms. The term "problems" is used when conflict among competing interests and values is not involved or is not being emphasized, "issues" when it is.

PROJECT FINANCING--Lending which is predicated more on the cash-generation capacity of a specific project than on the general credit-worthiness of the developer. Usually also involves long-term sales contracts and specific obligations with respect to completion and operation of the project.

PROJECT INDEPENDENCE--A program initiated in March 1974 designed to improve the energy position of the United States and perhaps to gain independence from foreign energy sources by 1985.

PUBLIC DOMAIN--Original public lands which have never left federal ownership; also, lands in federal ownership which were obtained by the government in exchange for public lands or for timber on such lands; also, original public domain lands which have reverted to federal ownership through operation of the public land laws.

RECLAMATION--Restoring mined land to productive use; includes replacement of topsoil, restoration of surface topography, waste disposal, and fertilization and revegetation.

REGRADING--The movement of earth over a depression to change the shape of the land surface; a finer form of backfilling.

RESERVES--Resources of known location, quantity, and quality which are economically recoverable using currently available technologies.

RESOURCES--Mineral or ore estimates that include reserves, identified deposits that cannot presently be extracted due to economical or technological reasons, and other deposits that have not been discovered but whose existence is inferred.

RETORTING--The decomposition within a closed heating facility (retort) of the solid hydrocarbon kerogen in oil shale to produce a variety of gases and a liquid hydrocarbon which can be upgraded to produce a synthetic crude oil.

RIGHT-OF-WAY--The legal right for use, occupancy, or access across land or water areas for a specified purpose or purposes, such as the construction of gas or oil pipelines. Such use on federal land is authorized by permit, lease, easement, or license. On patented lands, it is acquired by easement or purchase.

ROLLING STOCK--Railroad cars.

RUSSIAN THISTLE--A prickly European herb (Salsola kali tenuifolia) that is a serious pest in North America; also called Russian tumbleweed.

SALVAGED WATER--Water saved from current use which can be applied to another use.

SCIENCE COURT--A proposed "court" of scientific experts who will identify the significant science and technology questions related to public policy decisions, conduct adversary proceedings over the issues, and issue a judgment pertaining to the disputed technical questions.

SEAM--A bed of coal or other valuable mineral of any thickness.

SEEP--A spot where fluid (as water, oil, or gas) contained in the ground oozes slowly to the surface and often forms a pool.

SEDIMENTATION--The action or process of forming or depositing sediment (material deposited by water, wind, or glaciers).

701 PROGRAM--A federal program to provide financial assistance to local governments for county-wide land-use programs.

SEVERANCE TAX--A tax on the removal of minerals from the ground, usually levied as so many cents per barrel of oil or per thousand cubic feet of gas. The tax is sometimes levied as a percentage of the gross value of the minerals removed.

SITE SCREENING--A method which eliminates areas as possible sites for energy facilities on the basis of several criteria. Each stage of the process eliminates those locations that are unacceptable for a particular criterion. When all the unacceptable locations for each criterion are identified, the remaining sites are theoretically favorable for all criteria.

SLURRY PIPELINE--A pipeline through which coal (in the form of a mixture of water and coal) is transported.

SNOWPACK--The amount of annual accumulation of snow at higher elevations in the western United States, usually expressed in terms of average water equivalent.

SOFT MINERALS--Minerals such as oil and gas.

SOIL PERMEABILITY--The ability of an area of land to conduct fluids.

SOLUTIONAL MINING--The extraction of soluble minerals from subsurface strata by injection of fluids and the controlled removal of mineral-laden solutions.

SPENT SHALE--The material remaining after the kerogen is removed from oil shale by retorting. Its volume is greater than that of the original oil shale.

SPOIL PROPERTIES--Physical and chemical characteristics of refuse resulting from mining and processing operations, e.g., coal mining operations.

STAKEHOLDERS--Individuals who have a vested interest in decisions affecting development of western energy resources.

STATE IMPLEMENTATION PLAN (SIP)--Required by the Clean Air Act of 1970, SIP's outline state procedures for enforcing national ambient air standards and for monitoring the performance of local programs.

STRIP AND SHIP SITING--Determining the transport corridor through which it is possible to ship coal as coal instead of converted energy forms.

STRIP MINING--A mining method that entails the complete removal of all material from over the resource to be mined in a series of rows or strips; also referred to as surface mining.

STRIPPABLE RESERVES--Resources of known location, quantity, and quality, which are economically recoverable using currently available stripmining techniques.

SUBSIDENCE--The sinking, descending, or lowering of the land surface; the surface depression over an underground mine that has been created by subsurface caving.

SULFATES--A class of secondary pollutants that includes acid-sulfates and neutral metallic sulfates.

SULFUR DIOXIDE (SO_2) SCRUBBERS--Equipment used to remove sulfur dioxide pollutants from stack gas emissions, usually by means of a liquid sorbent.

SURFACE MINING--Mining method whereby the overlying materials are removed to expose the mineral for extraction.

SYNTHETIC FUELS--Artificially produced fuels.

SYNTHETIC NATURAL GAS (SNG)--Gas produced from a fossil fuel such as coal, oil shale, or organic material and having a heat content of about 1,000 Btu's per cubic foot.

TECHNOLOGICAL FIX--The application of technology to resolve social problems rather than seeking resolutions through behavioral or attitudinal change.

TECHNOLOGY ASSESSMENT--An examination (generally based on previously completed research rather than initiating new primary research) of the second and higher order consequences of technological innovation. TA attempts to balance these consequences against first-order benefits by identifying and analyzing alternative policies and implementation strategies so that the process of coping with scientific invention can occur in conjunction with, rather than after such invention.

THERMAL DISCHARGE--High temperature point source water pollutants that could prove hazardous to indigenous shellfish, fish, and wildlife in and on the body of water into which the discharge is made.

THROUGHPUT--The volume of feedstock charged to a process equipment unit during a specified time; the quantity of ore or other material passed through a mill or a section of a mill in a given time or at a given rate.

TRACE ELEMENT--A nonessential element found in small quantities (usually less than 1.0%) in a mineral. Also known as accessory element; quest element.

"208" PROGRAM--Federal Water Grant Program to make funds available to local jurisdictions for waste treatment facilities.

UNIT TRAIN--A system for delivering coal in which a string of cars, with distinctive markings and loaded to full visible capacity, is operated without service frills or stops along the way for cars to be cut in and out.

URANIUM TAILINGS--Uranium refuse material separated as residue in the preparation of various products such as ores.

VARIANCE POLICY--The procedure whereby a facility may receive a variance from the sulfur dioxide limits allowed for Class I areas whose air quality is cleaner than the Ambient Air Quality Standards.

VERTICAL INTEGRATION--Participation by one company in more than one level of an energy resource system; such participation may range from exploration for a resource through the distribution of the resource to consumers.

VOLATILE MATTER--Matter that can easily be vaporized at relatively low temperatures or exploded.

WATER INTENSIVE FORAGE CROPS--Crops such as alfalfa which consume relatively large quantities of water through evapotranspiration.

WATERSHED--Total land area above a given point on a stream or waterway that contributes runoff to that point.

WILDERNESS AREA--Federal lands placed under the National Wilderness Preservation System by the Wilderness Act of 1964. Subject to existing uses and rights, commercial enterprises, permanent roads, buildings, motorboats, airplanes, etc., are forbidden in any land designated as part of the wilderness system.

WINDFALL PROFITS--Profits which occur because of a one-time, unexpected event, e.g., profits in the coal industry occasioned by a sudden increase in the price of oil.

YELLOWCAKE--The product of the milling process in uranium fuel cycle. It contains 80 to 83 percent uranium oxide (U_3O_8).

ZERO DISCHARGE--A goal of the Federal Water Pollution Control Act Amendments of 1972 to eliminate all point-source pollution of navigable water by 1985.

*U.S. GOVERNMENT PRINTING OFFICE : 1979 0-620-007/3778

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